The heart of Robotics

RAPID reference manual

RAPID reference manual - part1a, Instructions A-R

Controller software IRC5
RobotWare 5.0

ABB

RAPID reference manual
3HAC 16581-1
Revision B

Controller software IRC5
RAPID reference manual - part 1a, Instructions A-R

RobotWare 5.0

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AccSet - Reduces the acceleration

AccSet is used when handling fragile loads. It allows slower acceleration and deceleration, which results in smoother robot movements.

This instruction can only be used in the *Main* task or, if in a MultiMove System, in Motion tasks.

Examples

AccSet 50, 100;

The acceleration is limited to 50% of the normal value.

AccSet 100, 50;

The acceleration ramp is limited to 50% of the normal value.

Arguments

AccSet **Acc Ramp**

Acc Data type: *num*

Acceleration and deceleration as a percentage of the normal values.
100% corresponds to maximum acceleration. Maximum value: 100%.
Input value < 20% gives 20% of maximum acceleration.

Ramp Data type: *num*

The rate at which acceleration and deceleration increases as a percentage of the normal values (see Figure 1). Jerking can be restricted by reducing this value.
100% corresponds to maximum rate. Maximum value: 100%.
Input value < 10% gives 10% of maximum rate.

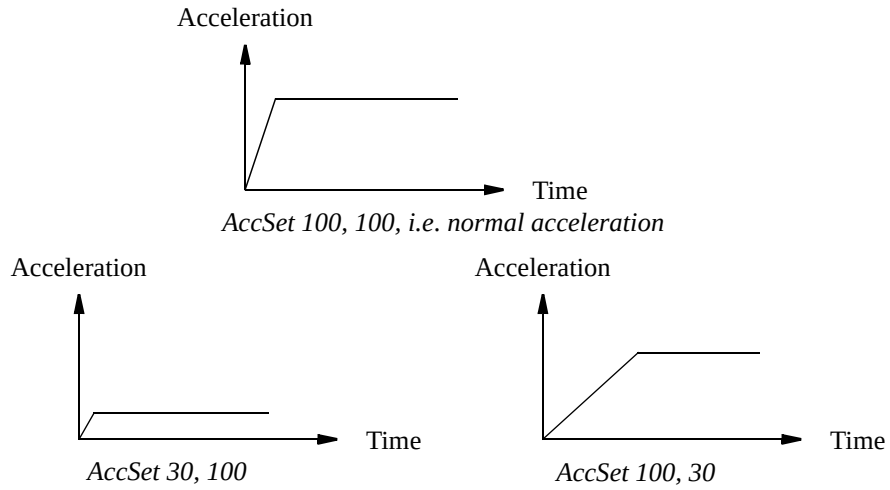


Figure 1 Reducing the acceleration results in smoother movements.

Program execution

The acceleration applies to both the robot and external axes until a new *AccSet* instruction is executed.

The default values (100%) are automatically set

- at a cold start-up
- when a new program is loaded
- when starting program executing from the beginning.

Syntax

AccSet
[Acc ':='] < expression (**IN**) of *num* > ','
[Ramp ':='] < expression (**IN**) of *num* > ';'

Related information

	Described in:
Positioning instructions	RAPID Summary - Motion

ActUnit - Activates a mechanical unit

ActUnit is used to activate a mechanical unit.

It can be used to determine which unit is to be active when, for example, common drive units are used.

This instruction can only be used in the *Main* task or, if in a MultiMove System, in Motion tasks.

Example

ActUnit orbit_a;

Activation of the *orbit_a* mechanical unit.

Arguments

ActUnit MechUnit

MechUnit *(Mechanical Unit)* Data type: *mecunit*

The name of the mechanical unit that is to be activated.

Program execution

When the robot and external axes have come to a standstill, the specified mechanical unit is activated. This means that it is controlled and monitored by the robot.

If several mechanical units share a common drive unit, activation of one of these mechanical units will also connect that unit to the common drive unit.

Limitations

Instruction ActUnit cannot be used in

- program sequence StorePath ... RestoPath
- event routine RESTART

Syntax

ActUnit
[MechUnit ':='] < variable (**VAR**) of *mecunit*> ';'

Related information

	Described in:
Deactivating mechanical units	Instructions - DeactUnit
Mechanical units	Data Types - mecunit
More examples	Instructions - DeactUnit

Add - Adds a numeric value

Add is used to add or subtract a value to or from a numeric variable or persistent.

Examples

Add reg1, 3;

3 is added to *reg1*, i.e. reg1:=reg1+3.

Add reg1, -reg2;

The value of *reg2* is subtracted from *reg1*, i.e. reg1:=reg1-reg2.

Arguments

Add Name AddValue

Name Data type: *num*

The name of the variable or persistent to be changed.

AddValue Data type: *num*

The value to be added.

Syntax

Add
[Name ':='] < var or pers (**INOUT**) of *num* > ','
[AddValue ':='] < expression (**IN**) of *num* > ';'

Related information

	Described in:
Incrementing a variable by 1	Instructions - Incr
Decrementing a variable by 1	Instructions - Decr
Changing data using an arbitrary	Instructions - :=expression, e.g. multiplication

AliasIO - Define I/O signal with alias name

AliasIO is used to define a signal of any type with an alias name or to use signals in built-in task modules.

Signals with alias names can be used for predefined generic programs, without any modification of the program before running in different robot installations.

The instruction *AliasIO* must be run before any use of the actual signal. See example 1 below for *loaded* modules and example 2 below for *builtin* modules.

Example 1

```
VAR signaldo alias_do;

PROC prog_start()
                    AliasIO config_do, alias_do;
ENDPROC
```

The routine *prog_start* is connected to the START event in system parameters. The program defined digital output signal *alias_do* is connected to the configured digital output signal *config_do* at program start (start the program from beginning).

Arguments

AliasIO **FromSignal ToSignal**

FromSignal Data type: *signalxx* or *string*

Loaded modules:

The signal identifier named according to the configuration (data type *signalxx*) from which the signal descriptor is copied. The signal must be defined in the IO configuration.

Built-in modules:

A reference (CONST, VAR, PERS or parameter of these) containing the name of the signal (data type *string*) from which the signal descriptor after search in the system is copied. The signal must be defined in the IO configuration.

ToSignal Data type: *signalxx*

The signal identifier according to the program (data type *signalxx*) to which the signal descriptor is copied. The signal must be declared in the RAPID program.

The same data type must be used (or find) for the arguments *FromSignal* and *ToSignal* and must be one of type *signalxx* (*signalai*, *signalao*, *signaldi*, *signaldo*, *signalgi* or *signalgo*).

Program execution

The signal descriptor value is copied from the signal given in argument *FromSignal* to the signal given in argument *ToSignal*.

Example 2

```
VAR signaldi alias_di;

PROC prog_start()
                    CONST string config_string := "config_di";
                    AliasIO config_string, alias_di;
ENDPROC
```

The routine *prog_start* is connected to the START event in system parameters. The program defined digital output signal *alias_di* is connected to the configured digital output signal *config_di* (via constant *config_string*) at program start (start the program from the beginning).

Limitation

When starting the program, the alias signal cannot be used until the *AliasIO* instruction is executed.

Instruction *AliasIO* **must** be placed

- either in the event routine executed at program start (event START)
- or in the program part executed after every program start (before use of the signal)

In order to prevent mistakes it is not recomended to use dynamic reconnection of an *AliasIO* signal to different physical signals.

Syntax

AliasIO
[FromSignal ':='] < reference (**REF**) of *anytype*> ','
[ToSignal ':='] < variable (**VAR**) of *anytype*> ';'

Related information

	Described in:
Input/Output instructions	RAPID Summary - Input and Output Signals
Input/Output functionality in general	Motion and I/O Principles - I/O Principles
Configuration of I/O	System Parameters
Defining event routines	System Parameters
Loaded/Built-in task modules	System Parameters

":=" - Assigns a value

The ":=" instruction is used to assign a new value to data. This value can be anything from a constant value to an arithmetic expression, e.g. *reg1+5*reg3*.

Examples

reg1 := 5;

reg1 is assigned the value *5*.

reg1 := reg2 - reg3;

reg1 is assigned the value that the *reg2-reg3* calculation returns.

counter := counter + 1;

counter is incremented by one.

Arguments

Data := Value

Data Data type: All

The data that is to be assigned a new value.

Value Data type: Same as Data

The desired value.

Examples

tool1.tframe.trans.x := tool1.tframe.trans.x + 20;

The TCP for *tool1* is shifted *20* mm in the X-direction.

pallet{5,8} := Abs(value);

An element in the *pallet* matrix is assigned a value equal to the absolute value of the *value* variable.

Limitations

The data (whose value is to be changed) must not be

- a constant
- a non-value data type.

The data and value must have similar (the same or alias) data types.

Syntax

(EBNF)
<assignment target> ’:=’ <expression> ’;’
<assignment target> ::=
<variable>
| <persistent>
| <parameter>
| **<VAR>**

Related information

	Described in:
Expressions	Basic Characteristics - Expressions
Non-value data types	Basic Characteristics - Data Types
Assigning an initial value to data	Basic Characteristics - Data Programming and Testing
Manually assigning a value to data	Programming and Testing

BitClear - Clear a specified bit in a byte data

BitClear is used to clear (set to 0) a specified bit in a defined *byte* data.

Examples

```
CONST num parity_bit := 8;
VAR byte data1 := 130;

BitClear data1, parity_bit;
```

Bit number 8 (**parity_bit) in the variable data1 will be set to 0, e.g. the** content of the variable *data1* will be changed from 130 to 2 (decimal representation).

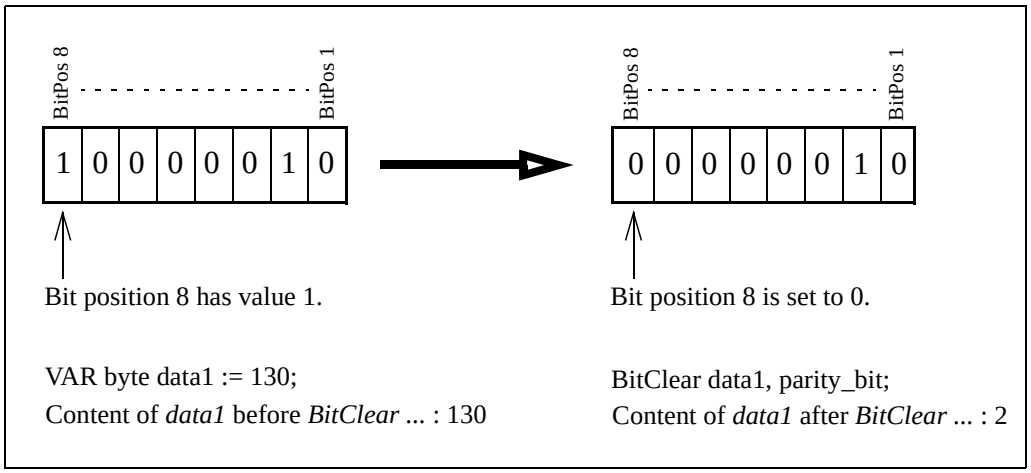

BitPos 8
BitPos 1
1 0 0 0 0 0 1 0
Bit position 8 has value 1.
VAR byte data1 := 130;
Content of data1 before BitClear ... : 130
BitPos 8
BitPos 1
0 0 0 0 0 0 1 0
Bit position 8 is set to 0.
BitClear data1, parity_bit;
Content of data1 after BitClear ... : 2

Figure 2 Bit manipulation of data type byte when using BitClear

Arguments

BitClear BitData BitPos

BitData Data type: *byte*

The bit data, in decimal representation, to be changed.

BitPos *(Bit Position)* Data type: *num*

The bit position (1-8) in the *BitData* to be set to 0.

Limitations

The range for a data type *byte* is 0 - 255 decimal.

The bit position is valid from 1 - 8.

Syntax

BitClear
[BitData':='] < var or pers (**INOUT**) of *byte* > ','
[BitPos':='] < expression (**IN**) of *num* > ';'

Related information

	Described in:
Set a specified bit in a byte data	Instructions - BitSet
Check if a specified bit in a byte data is set	Functions - BitCheck
Other bit functions	RAPID Summary - Bit Functions

BitSet - Set a specified bit in a byte data

BitSet is used to set a specified bit to 1 in a defined *byte* data.

Examples

CONST num parity_bit := 8;
VAR byte data1 := 2;

BitSet data1, parity_bit;

Bit number 8 (**parity_bit) in the variable data1 will be set to 1, e.g. the** content of the variable *data1* will be changed from 2 to 130 (decimal representation).

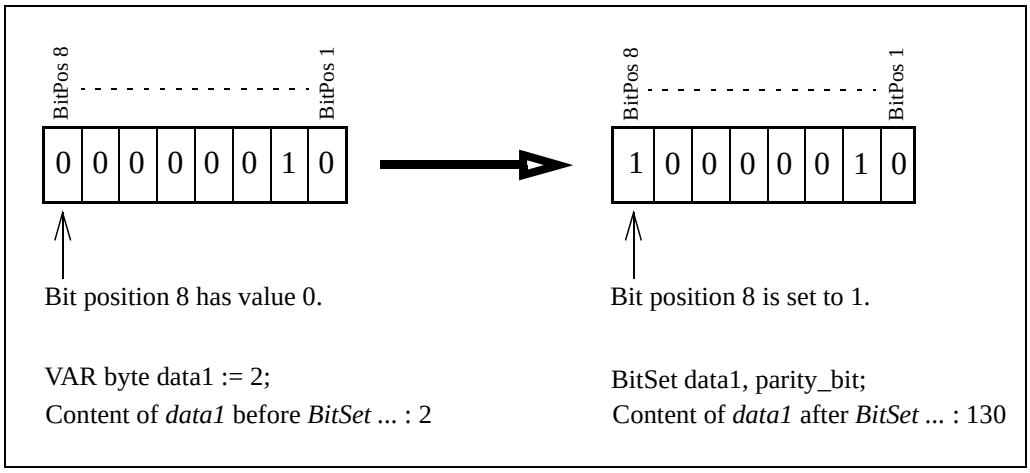

BitPos 8
BitPos 1
0 0 0 0 0 0 1 0
Bit position 8 has value 0.
VAR byte data1 := 2;
Content of data1 before BitSet ... : 2
BitPos 8
BitPos 1
1 0 0 0 0 0 1 0
Bit position 8 is set to 1.
BitSet data1, parity_bit;
Content of data1 after BitSet ... : 130

Figure 3 Bit manipulation of data type byte when using BitSet

Arguments

BitSet **BitData BitPos**

BitData Data type: *byte*

The bit data, in decimal representation, to be changed.

BitPos *(Bit Position)* Data type: *num*

The bit position (1-8) in the *BitData* to be set to 1.

Limitations

The range for a data type *byte* is 0 - 255 decimal.

The bit position is valid from 1 - 8.

Syntax

```
BitSet
   [ BitData':=' ] < var or pers (INOUT) of byte > ','
   [ BitPos':=' ] < expression (IN) of num > ';'
```

Related information

	Described in:
Clear a specified bit in a byte data	Instructions - BitClear
Check if a specified bit in a byte data is set	Functions - BitCheck
Other bit functions	RAPID Summary - Bit Functions

BookErrNo - Book a RAPID system error number

BookErrNo is used to book a new RAPID system error number.

Examples

```
! Introduce a new error number in a glue system
! Note: The new error variable must be declared with the initial value -1
VAR errnum ERR_GLUEFLOW := -1;

! Book the new RAPID system error number
BookErrNo ERR_GLUEFLOW;
```

The variable *ERR_GLUEFLOW* will be assigned to a free system error number for use in the RAPID code.

```
! Use the new error number
IF di1 = 0 THEN
  RAISE ERR_GLUEFLOW;
ELSE
...
ENDIF

! Error handling
ERROR
  IF ERRNO = ERR_GLUEFLOW THEN
    ...
  ELSE
    ...
  ENDIF
```

If the digital input *di1* is 0 the new booked error number will be raised and the system error number *ERRNO* will be set to the new booked error number. The error handling of those user generated errors can then be handled in the error handler as usual.

Arguments

BookErrNo ErrorName

ErrorName Data type: *errnum*

The new RAPID system error variable name.

Limitations

The new error variable must not be declared as a routine variable.

The new error variable must be declared with an initial value of -1, that gives the information that this error should be a RAPID system error.

Syntax

BookErrNo
[ErrorName':='] < variable (**VAR**) of *errnum* > ';'

Related information

	Described in:
Error handling	Basic Characteristics -Error Recovery
Error number	Data types - errnum
Call an error handler	Instructions - RAISE

Break - Break program execution

Break is used to make an immediate break in program execution for RAPID program code debugging purposes.

Example

```
..
Break;
...
```

Program execution stops and it is possible to analyse variables, values etc. for debugging purposes.

Program execution

The instruction stops program execution at once, without waiting for the robot and external axes to reach their programmed destination points for the movement being performed at the time. Program execution can then be restarted from the next instruction.

If there is a *Break* instruction in some event routine, the routine will be executed from the beginning of the next event.

Syntax

```
Break';'
```

Related information

	Described in:
Stopping for program actions	Instructions - Stop
Stopping after a fatal error	Instructions - EXIT
Terminating program execution	Instructions - EXIT
Only stopping robot movements	Instructions - StopMove

CallByVar - Call a procedure by a variable

CallByVar (*Call By Variable*) can be used to call procedures with specific names, e.g. *proc_name1*, *proc_name2*, *proc_name3* ... *proc_namex* via a variable.

Example

```
reg1 := 2;
CallByVar “proc”, reg1;
```

The procedure *proc2* is called.

Arguments

CallByVar Name Number

Name Data type: *string*

The first part of the procedure name, e.g. *proc_name*.

Number Data type: *num*

The numeric value for the number of the procedure. This value will be converted to a string and gives the 2:nd part of the procedure name e.g. *1*. The value must be a positive integer.

Example

Static selection of procedure call

```
TEST reg1
   CASE 1:
      lf_door door_loc;
   CASE 2:
      rf_door door_loc;
   CASE 3:
      lr_door door_loc;
   CASE 4:
      rr_door door_loc;
   DEFAULT:
      EXIT;
ENDTEST
```

Depending on whether the value of register *reg1* is 1, 2, 3 or 4, different procedures are called that perform the appropriate type of work for the selected door. The door location in argument *door_loc*.

Dynamic selection of procedure call with RAPID syntax

reg1 := 2;
%”proc”+NumToStr(reg1,0)% door_loc;

The procedure *proc2* is called with argument *door_loc*.

Limitation: All procedures must have a specific name e.g. *proc1, proc2, proc3.*

Dynamic selection of procedure call with CallByVar

reg1 := 2;
CallByVar “proc”,reg1;

The procedure *proc2* is called.

Limitation: All procedures must have specific name, e.g. *proc1, proc2, proc3,* and no arguments can be used.

Limitations

Can only be used to call procedures without parameters.

Can not be used to call LOCAL procedures.

Execution of CallByVar takes a little more time than execution of a normal procedure call.

Error handling

In the event of a reference to an unknown procedure, the system variable ERRNO is set to ERR_REFUNKPRC.

In the event of the procedure call error (not procedure), the system variable ERRNO is set to ERR_CALLPROC.

These errors can be handled in the error handler.

Syntax

CallByVar
[Name ‘:=’] <expression (**IN**) of *string*>’,’
[Number ‘:=‘] <expression (**IN**) of *num*>’;’

Related information

	Described in:
Calling procedures	Basic Characteristic - Routines, Operator's manual - IRC5 with FlexPendant

CancelLoad - Cancel loading of a module

CancelLoad is used to cancel the loading of a module that is being or has been loaded with the instruction *StartLoad*.

CancelLoad can be used only between the instruction Startload ... WaitLoad.

Example

CancelLoad load1;

The load session *load1* is cancelled.

Arguments

CancelLoad LoadNo

LoadNo Data type: *loadsession*

Reference to the load session, fetched by the instruction *StartLoad.*

Examples

```
VAR loadsession load1;

StartLoad “HOME:”\File:=”PART_B.MOD”,load1;
...
IF .....................
   CancelLoad load1;
   StartLoad “HOME:”\File:=”PART_C.MOD”,load1;
ENDIF
...
WaitLoad load1;
```

The instruction *CancelLoad* will cancel the on-going loading of the module PART_B.MOD and make it possible to in stead load PART_C.MOD.

Error handling

If the variable specified in argument *LoadNo* is not in use, meaning that no load session is in use, the system variable ERRNO is set to ERR_LOADNO_NOUSE. This error can then be handled in the error handler.

Syntax

CancelLoad
[LoadNo ':='] < variable (**VAR**) of *loadsession* > ';'

Related information

	Described in:
Load a program module during execution	Instructions - StartLoad
Connect the loaded module to the task	Instructions - WaitLoad
Load session	Data Types - loadsession
Load a program module	Instructions - Load
Unload a program module	Instructions - UnLoad
Accept unsolved references	System Parameters - Controller/Task/ BindRef

CirPathMode - Tool reorientation during circle path

CirPathMode (Circle Path Mode) makes it possible to select different modes to reorientate the tool during circular movements.

This instruction can only be used in the *Main* task or, if in a MultiMove System, in Motion tasks.

Example

CirPathMode \PathFrame;

Standard mode for tool reorientation in the actual path frame from the start point to the *ToPoint* during all succeeding circular movements.
This is default in the system.

CirPathMode \ObjectFrame;

Modified mode for tool reorientation in actual object frame from the start point to the *ToPoint* during all succeeding circular movements.

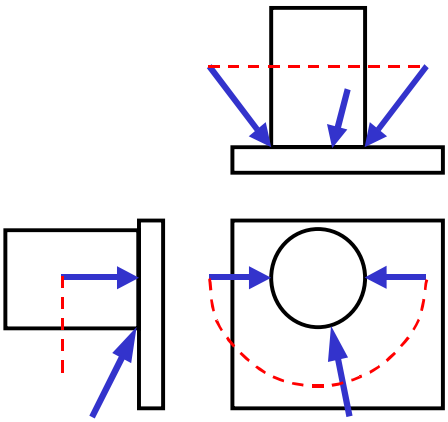
CirPathMode \CirPointOri;

Modified mode for tool reorientation from the start point via the programmed *CirPoint* orientation to the *ToPoint* during all succeeding circular movements.

Description

PathFrame

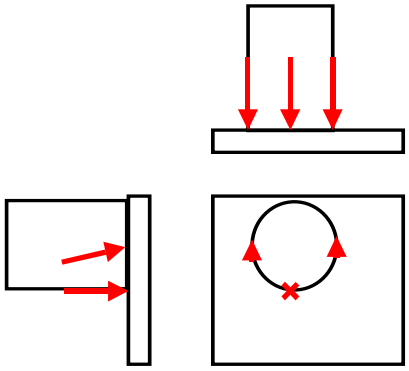
The picture shows the tool reorientation for the standard mode *PathFrame*.



The arrows shows the tool from wrist centre point to tool centre point for the programmed points.
The path for the wrist centre point is dotted in the figure.

The *PathFrame* mode make it easy to get the same angle of the tool around the cylinder. The robot wrist will not go through the programmed orientation in the *CirPoint*.

Use of standard mode *PathFrame* with fixed tool orientation:

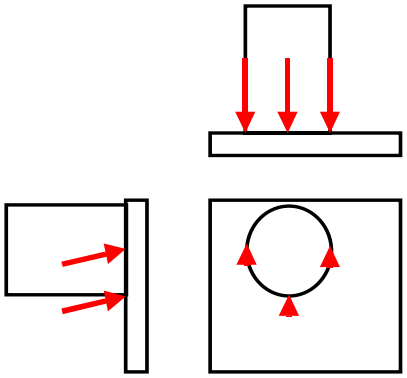


This picture shows the obtained orientation of the tool in the middle of the circle using a leaning tool and *PathFrame* mode.

Compare with the figure below when *ObjectFrame* mode is used

ObjectFrame

Use of modified mode *ObjectFrame* with fixed tool orientation:



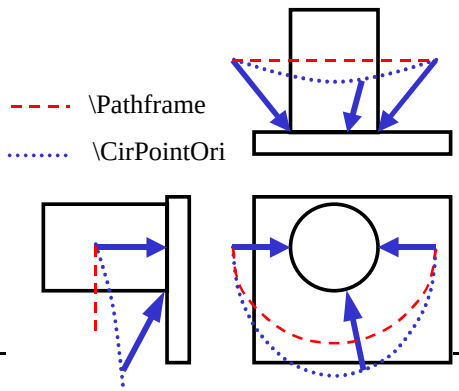
This picture shows the obtained orientation of the tool in the middle of the circle using a leaning tool and *ObjectFrame* mode.

This mode will make a linear reorientation of the tool in the same way as for *MoveL*. The robot wrist will not go through the programmed orientation in the *CirPoint.*

Compare with the figure above when *PathFrame* mode is used

CirPointOri

The picture shows the different tool reorientation between the standard mode *PathFrame* and the modified mode *CirPointOri*.



The arrows shows the tool from wrist centre point to tool centre point for the programmed points.
The different paths for the wrist centre point are dotted in the figure.

The *CirPointOri* mode will make the robot wrist to go through the programmed orientation in the *CirPoint.*

Arguments

CirPathMode **[\PathFrame] | [\ObjectFrame] | [\Cir-**

PointOri]

[\PathFrame] Data type: *switch*

During the circular movement the reorientaion of the tool is done continuous from the start point orientation to the *ToPoint* orientation in the actual path frame. This is the standard mode in the system.

[\ObjectFrame] Data type: *switch*

During the circular movement the reorientaion of the tool is done continuous from the start point orientation to the *ToPoint* orientation in the actual object frame.

[\CirPointOri] Data type: *switch*

During the circular movement the reorientaion of the tool is done continuous from the start point orientation to the programmed *CirPoint* orientation and further to the *ToPoint* orientation.

Only programming *CirPathMode;* without any switch result in the same as *CirPointOri \PathFrame;*

Program execution

The specified circular tool reorientation mode applies for the next executed robot circular movements of any type (*MoveC, SearchC, TriggC, MoveCDO, MoveCSync, ArcC, PaintC* ...) and is valid until a new *CirPathMode* (or obsolete *CirPathReori)* instruction is executed.

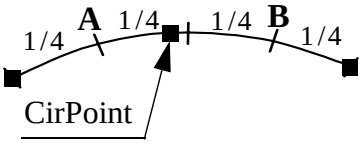
The standard circular reorientation mode (*CirPathMode \PathFrame*) is automatically set

- at a cold start-up
- when a new program is loaded
- when starting program executing from the beginning.

Limitations

The instruction only affects circular movements.

When using the *CirPointOri* mode, the *CirPoint* must be between the points **A** and **B** according to the figure below to make the circle movement to go **through** the programmed orientation in the *CirPoint.*



If working in wrist singularity area and the instruction *SingArea \Wrist* has been executed, the instruction *CirPathMode* has no effect because the system then select another tool reorientation mode for circular movements (joint interpolation).

This instruction replace the old instruction *CirPathReori*
(will work even in future but will not be documented any more).

Syntax

CirPathMode
[‘\’PathFrame] | [‘\’ObjectFrame] | [‘\’CirPointOri] ‘;’

Related information

	Described in:
Interpolation	Motion Principles - Positioning during Program Execution
Motion settings data	Data Types - motsetdata
Circular move instruction	Instructions - MoveC

Clear - Clears the value

Clear is used to clear a numeric variable or persistent , i.e. it sets it to 0.

Example

Clear reg1;

Reg1 is cleared, i.e. reg1:=0.

Arguments

Clear Name

Name Data type: *num*

The name of the variable or persistent to be cleared.

Syntax

Clear
[Name ':='] < var or pers (**INOUT**) of *num* > ';'

Related information

	Described in:
Incrementing a variable by 1	Instructions - Incr
Decrementing a variable by 1	Instructions - Decr

ClearIOBuff - Clear input buffer of a serial channel

ClearIOBuff (*Clear I/O Buffer*) is used to clear the input buffer of a serial channel. All buffered characters from the input serial channel are discarded.

Example

```
VAR iodev channel2;
...
Open "com2:", channel2 \Bin;
ClearIOBuff channel2;
WaitTime 0.1;
```

The input buffer for the serial channel referred to by *channel2* is cleared. The waittime guarantees the clear operation enough time to finish.

Arguments

ClearIOBuff IODevice

IODevice Data type: *iodev*

The name (reference) of the serial channel whose input buffer is to be cleared.

Program execution

All buffered characters from the input serial channel are discarded. Next read instructions will wait for new input from the channel.

Limitations

This instruction can only be used for serial channels.
No wait for acknowledge of the operation is done. A waittime 0.1 after the instruction is recommended to give the operation enough time in every application.

Error handling

If trying to use the instruction on a file, the system variable ERRNO is set to ERR_FILEACC. This error can then be handled in the error handler.

Syntax

ClearIOBuff
[IODevice ':='] <variable (**VAR**) of *iodev*>';'

Related information

	Described in:
Opening a serial channel	RAPID Summary - Communication

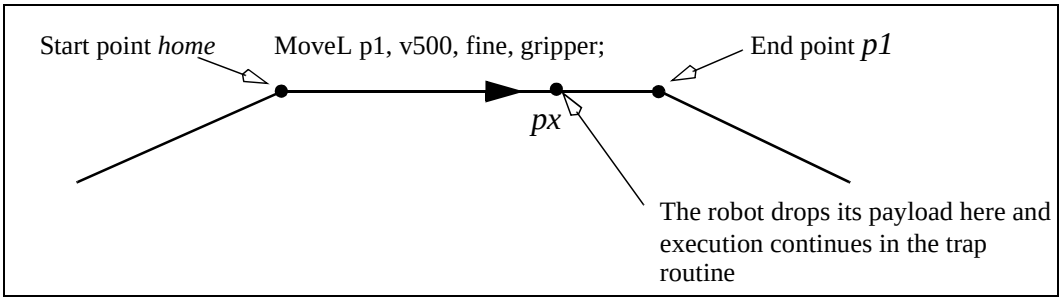
ClearPath - Clear current path

ClearPath (*Clear Path*) clear the whole motion path on the current motion path level (base level or *StorePath* level).

With motion path means all the movement segments from any move instructions which has been executed in RAPID but not performed by the robot at the execution time of *ClearPath*.

The robot must be in a stop point position or must be stopped by *StopMove* before the instruction *ClearPath* can be executed.

Example


Start point *home*
MoveL p1, v500, fine, gripper;
End point *p1*
px
The robot drops its payload here and execution continues in the trap routine

In the following program example, the robot moves from the position *home* to the position *p1*. At the point *px* the signal *di1* will indicate that the payload has been dropped. The execution continues in the trap routine *gohome*. The robot will stop moving (start the braking) at *px*, the path will be cleared, the robot will move to position *home*. The error will be raised up to the calling routine *minicycle* and the whole user defined program cycle *proc1 .. proc2* will be executed from beginning one more time.

```
VAR intnum drop_payload;
CONST errnum ERR_DROP_LOAD := 1;

PROC minicycle()
   .........
   proc1;
   .........
   ERROR (ERR_DROP_LOAD)
      RETRY;
ENDPROC
```

```
PROC proc1()
   .........
   proc2;
   .........
ENDPROC

PROC proc2()
   CONNECT drop_payload WITH gohome;
   ISignalDI \Single, di1, 1, drop_payload;
   MoveL p1, v500, fine, gripper;
   ...........
   IDelete drop_payload
ENDPROC

TRAP gohome
   StopMove \Quick;
   ClearPath;
   IDelete drop_payload;
   MoveL home, v500, fine, gripper;
   RAISE ERR_DROP_LOAD;
   ERROR
      RAISE;
ENDTRAP
```

If the same program is being run but **without** *StopMove* **and** *ClearPath* in the trap routine *gohome*, the robot will continue to position *p1* before going back to position *home*.

If programming *MoveL home* with flying-point (zone) instead of stop-point (*fine*), the movement is going on during the *RAISE* to the error handler in procedure *minicycle* and further until the movement is ready.

Syntax

ClearPath ';'

Related information

	Described in:
Stop robot movements	Instructions - StopMove
Error recovery	RAPID Summary - Error Recovery Basic Characteristics - Error Recovery

ClearRawBytes - Clear the contents of rawbytes data

ClearRawBytes is used to set all the contents of a rawbytes variable to 0.

Example

```
VAR rawbytes raw_data;
VAR num integer := 8
VAR num float := 13.4;

PackRawBytes integer, raw_data, 1 \IntX := DINT;
PackRawBytes float, raw_data, (RawBytesLen(raw_data)+1) \Float4;

ClearRawBytes raw_data \FromIndex := 5;
```

In the first 4 bytes the value of *integer* is placed (from index 1) and in the next 4 bytes starting from index 5 the value of *float*.

The last instruction in the example clears the contents of *raw_data*, starting at index *5*, i.e. *float* will be cleared, but *integer* is kept in *raw_data*.
Current length of valid bytes in *raw_data* is set to 4.

Arguments

ClearRawBytes RawData [\FromIndex]

RawData Data type: *rawbytes*

RawData is the data container which will be cleared.

[\FromIndex] Data type: *num*

With *FromIndex* it is specified, where to start clearing the contents of *RawData*. Everything is cleared to the end.

If *FromIndex* is not specified, all data starting at index 1 is cleared.

Program execution

Data from index 1 (default) or from *FromIndex* in the specified variable is reset to 0.

The current length of valid bytes in the specified variable is set to 0 (default) or to (*FromIndex* - 1) if *FromIndex* is programmed.

Syntax

```
ClearRawBytes
   [RawData ':=' ] < variable (VAR) of rawbytes>
   ['\'FromIndex ':=' <expression (IN) of num>]';'
```

Related information

	Described in:
rawbytes data	Data Types - *rawbytes*
Get the length of *rawbytes* data	Functions - *RawBytesLen*
Copy the contents of *rawbytes* data	Instructions - *CopyRawBytes*
Pack DeviceNet header into *rawbytes* data	Instructions - *PackDNHeader*
Pack data into *rawbytes* data	Instructions - *PackRawBytes*
Write *rawbytes* data	Instructions - *WriteRawBytes*
Read *rawbytes* data	Instructions - *ReadRawBytes*
Unpack data from *rawbytes* data	Instructions - *UnpackRawBytes*

ClkReset - Resets a clock used for timing

ClkReset is used to reset a clock that functions as a stop-watch used for timing.

This instruction can be used before using a clock to make sure that it is set to 0.

Example

ClkReset clock1;

The clock *clock1* is reset.

Arguments

ClkReset Clock

Clock Data type: *clock*

The name of the clock to reset.

Program execution

When a clock is reset, it is set to 0.

If a clock is running, it will be stopped and then reset.

Syntax

ClkReset
[Clock ':='] < variable (**VAR**) of *clock* > ';'

Related Information

	Described in:
Other clock instructions	RAPID Summary - System & Time

ClkStart - Starts a clock used for timing

ClkStart is used to start a clock that functions as a stop-watch used for timing.

Example

```
ClkStart clock1;
```

The clock *clock1* is started.

Arguments

ClkStart Clock

Clock Data type: *clock*

The name of the clock to start.

Program execution

When a clock is started, it will run and continue counting seconds until it is stopped.

A clock continues to run when the program that started it is stopped. However, the event that you intended to time may no longer be valid. For example, if the program was measuring the waiting time for an input, the input may have been received while the program was stopped. In this case, the program will not be able to “see” the event that occurred while the program was stopped.

A clock continues to run when the robot is powered down as long as the battery back-up retains the program that contains the clock variable.

If a clock is running it can be read, stopped or reset.

Example

```
VAR clock clock2;

ClkReset clock2;
ClkStart clock2;
WaitUntil DInput(di1) = 1;
ClkStop clock2;
time:=ClkRead(clock2);
```

The waiting time for *di1* to become 1 is measured.

Error handling

If the clock runs for 4,294,967 seconds (49 days 17 hours 2 minutes 47 seconds) it becomes overflowed and the system variable ERRNO is set to ERR_OVERFLOW.

The error can be handled in the error handler.

Syntax

ClkStart
[Clock ':='] < variable (**VAR**) of *clock* > ';'

Related Information

	Described in:
Other clock instructions	RAPID Summary - System & Time

ClkStop - Stops a clock used for timing

ClkStop is used to stop a clock that functions as a stop-watch used for timing.

Example

ClkStop clock1;

The clock *clock1* is stopped.

Arguments

ClkStop Clock

Clock Data type: *clock*

The name of the clock to stop.

Program execution

When a clock is stopped, it will stop running.

If a clock is stopped, it can be read, started again or reset.

Error handling

If the clock runs for 4,294,967 seconds (49 days 17 hours 2 minutes 47 seconds) it becomes overflowed and the system variable ERRNO is set to ERR_OVERFLOW.

The error can be handled in the error handler.

Syntax

ClkStop
[Clock ':='] < variable (**VAR**) of *clock* > ';'

Related Information

	Described in:
Other clock instructions	RAPID Summary - System & Time
More examples	Instructions - ClkStart

Close - Closes a file or serial channel

Close is used to close a file or serial channel.

Example

Close channel2;

The serial channel referred to by *channel2* is closed.

Arguments

Close IODevice

IODevice Data type: *iodev*

The name (reference) of the file or serial channel to be closed.

Program execution

The specified file or serial channel is closed and must be re-opened before reading or writing. If it is already closed, the instruction is ignored.

Syntax

Close
[IODevice ':='] <variable (**VAR**) of *iodev*>';'

Related information

	Described in:
Opening a file or serial channel	RAPID Summary - Communication

CloseDir - Close a directory

CloseDir is used to close a directory in balance with *OpenDir.*

Example

```
PROC lsdir(string dirname)
                    VAR dir directory;
                    VAR string filename;
                    OpenDir directory, dirname;
                    WHILE ReadDir(directory, filename) DO
                            TPWrite filename;
                    ENDWHILE
                    CloseDir directory;
ENDPROC
```

This example prints out the names of all files or subdirectories under the specified directory.

Arguments

CloseDir **Dev**

Dev Data type: *dir*

A variable with reference to the directory fetched with instruction *OpenDir.*

Syntax

CloseDir
[Dev':='] < variable (**VAR**) of *dir*>';'

Related information

	Described in:
Directory	dir
Open a directory	OpenDir
Read a directory	ReadDir
Check file type	IsFile

comment - Comment

Comment is only used to make the program easier to understand. It has no effect on the execution of the program.

Example

```
! Goto the position above pallet
MoveL p100, v500, z20, tool1;
```

A comment is inserted into the program to make it easier to understand.

Arguments

! Comment

Comment Text string

Any text.

Program execution

Nothing happens when you execute this instruction.

Syntax

(EBNF)
'!' {<character>} <newline>

Related information

	Described in:
Characters permitted in a comment	Basic Characteristics - Basic Elements
Comments within data and routine	Basic Characteristics- declarations Basic Elements

Compact IF - If a condition is met, then... (one instruction)

Compact IF is used when a single instruction is only to be executed if a given condition is met.

If different instructions are to be executed, depending on whether the specified condition is met or not, the *IF* instruction is used.

Examples

IF reg1 > 5 GOTO next;

If *reg1 is greater than 5*, program execution continues at the *next* label.

IF counter > 10 Set do1;

The *do1* signal is set if *counter > 10*.

Arguments

IF Condition ...

Condition Data type: *bool*

The condition that must be satisfied for the instruction to be executed.

Syntax

(EBNF)
IF <conditional expression> (<instruction> | **<SMT>**) ';'

Related information

	Described in:
Conditions (logical expressions)	Basic Characteristics - Expressions
IF with several instructions	Instructions - IF

ConfJ - Controls the configuration during joint movement

ConfJ (Configuration Joint) is used to specify whether or not the robot's configuration is to be controlled during joint movement. If it is not controlled, the robot can sometimes use a different configuration than that which was programmed.

With ConfJ\Off, the robot cannot switch main axes configuration - it will search for a solution with the same main axes configuration as the current one. It moves to the closest wrist configuration for axes 4 and 6.

This instruction can only be used in the *Main* task or, if in a MultiMove System, in Motion tasks.

Examples

```
ConfJ \Off;
MoveJ *, v1000, fine, tool1;
```

The robot moves to the programmed position and orientation. If this position can be reached in several different ways, with different axis configurations, the closest possible position is chosen.

```
ConfJ \On;
MoveJ *, v1000, fine, tool1;
```

The robot moves to the programmed position, orientation and axis configuration. If this is not possible, program execution stops.

Arguments

ConfJ **[\On] | [\Off]**

[\On] Data type: *switch*

The robot always moves to the programmed axis configuration. If this is not possible using the programmed position and orientation, program execution stops.

The IRB5400 robot will move to the pogrammed axis configuration or to an axis configuration close the the programmed one. Program execution will not stop if it is impossible to reach the programmed axis configuration.

[\Off] Data type: *switch*

The robot always moves to the closest axis configuration.

Program execution

If the argument *\On* (or no argument) is chosen, the robot always moves to the programmed axis configuration. If this is not possible using the programmed position and orientation, program execution stops before the movement starts.

If the argument *\Off* is chosen, the robot always moves to the closest axis configuration. This may be different to the programmed one if the configuration has been incorrectly specified manually, or if a program displacement has been carried out.

The control is active by default. This is automatically set

- at a cold start-up
- when a new program is loaded
- when starting program executing from the beginning.

Syntax

```
ConfJ
   [ ’\’ On] | [ ’\’ Off] ’;’
```

Related information

	Described in:
Handling different configurations	Motion Principles - Robot Configuration
Robot configuration during linear movement	Instructions - ConfL

ConfL - Monitors the configuration during linear movement

ConfL (Configuration Linear) is used to specify whether or not the robot's configuration is to be monitored during linear or circular movement. If it is not monitored, the configuration at execution time may differ from that at programmed time. It may also result in unexpected sweeping robot movements when the mode is changed to joint movement.

This instruction can only be used in the *Main* task or, if in a MultiMove System, in Motion tasks.

NOTE: For the IRB 5400 robot the monotoring is always off independent of what is specified in ConfL.

Examples

```
ConfL \On;
MoveL *, v1000, fine, tool1;
```

Program execution stops when the programmed configuration is not possible to reach from the current position.

```
SingArea \Wrist;
ConfL \On;
MoveL *, v1000, fine, tool1;
```

The robot moves to the programmed position, orientation and wrist axis configuration. If this is not possible, program execution stops.

```
ConfL \Off;
MoveL *, v1000, fine, tool1;
```

The robot moves to the programmed position and orientation, but to the closest possible axis configuration, which can be different from the programmed.

Arguments

ConfL **[\On] | [\Off]**

[\On] Data type: *switch*

The robot configuration is monitored.

[\Off] Data type: *switch*

The robot configuration is not monitored.

Program execution

During linear or circular movement, the robot always moves to the programmed position and orientation that has the closest possible axis configuration. If the argument *\On* (or no argument) is chosen, then the program execution stops as soon as there's a risk that the configuration of the programmed position not will be attained from the current position.

However, it is possible to restart the program again, although the wrist axes may continue to the wrong configuration. At a stop point, the robot will check that the configurations of all axes are achieved, not only the wrist axes.

If SingArea\Wrist is also used, the robot always moves to the programmed wrist axes configuration and at a stop point the remaining axes configurations will be checked.

If the argument *\Off* is chosen, there is no monitoring.

Monitoring is active by default. This is automatically set

- at a cold start-up
- when a new program is loaded
- when starting program executing from the beginning.
- A simple rule to avoid problems, both for *ConfL\On* and *\Off*, is to insert intermediate points to make the movement of each axis less than 90 degrees between points or more precisely, the sum of movements for any of the par of axes (1+4), (1+6), (3+4) or (3+6) should not exceed 180 degrees. If *ConfL\Off* is used with a big movement, it can cause stops directly or later in the program with error *50050 Position outside reach* or *50080 Position not compatible.*
  In a program with *ConfL\Off* it's recommended to have movements to known configurations points with "*ConfJ\On + MoveJ*" or "*ConfL\On + SingArea\Wrist + MoveL*" as start points for different program parts.

Syntax

```
ConfL
   [ '\' On] | [ '\' Off] ';'
```

Related information

	Described in:
Handling different configurations	Motion and I/O Principles- Robot Configuration
Robot configuration during joint movement	Instructions - ConfJ

CONNECT - Connects an interrupt to a trap routine

CONNECT is used to find the identity of an interrupt and connect it to a trap routine.

The interrupt is defined by ordering an interrupt event and specifying its identity. Thus, when that event occurs, the trap routine is automatically executed.

Example

```
VAR intnum feeder_low;
CONNECT feeder_low WITH feeder_empty;
ISignalDI di1, 1 , feeder_low;
```

An interrupt identity *feeder_low* is created which is connected to the trap routine *feeder_empty.* The interrupt is defined as *input di1 is getting high*. In other words, when this signal becomes high, the *feeder_empty* trap routine is executed.

Arguments

CONNECT Interrupt WITH Trap routine

Interrupt Data type: *intnum*

The variable that is to be assigned the identity of the interrupt.
This must not be declared within a routine (routine data).

Trap routine Identifier

The name of the trap routine.

Program execution

The variable is assigned an interrupt identity which can then be used when ordering or disabling interrupts. This identity is also connected to the specified trap routine.

Note that before an event can be handled, an interrupt must also be ordered, i.e. the event specified.

Limitations

An interrupt (interrupt identity) cannot be connected to more than one trap routine. Different interrupts, however, can be connected to the same trap routine.

When an interrupt has been connected to a trap routine, it cannot be reconnected or transferred to another routine; it must first be deleted using the instruction *IDelete*.

Error handling

If the interrupt variable is already connected to a TRAP routine, the system variable ERRNO is set to ERR_ALRDYCNT.

If the interrupt variable is not a variable reference, the system variable ERRNO is set to ERR_CNTNOTVAR.

If no more interrupt numbers are available, the system variable ERRNO is set to ERR_INOMAX.

These errors can be handled in the ERROR handler.

Syntax

(EBNF)
CONNECT <connect target> **WITH** <trap>‘;’

<connect target> ::= <variable>
| <parameter>
| <VAR>
<trap> ::= <identifier>

Related information

	Described in:
Summary of interrupts	RAPID Summary - Interrupts
More information on interrupt management	Basic Characteristics- Interrupts

CopyFile - Copy a file

CopyFile is used to make a copy of an existing file.

Examples

CopyFile “HOME:/myfile”, “HOME:/yourfile;

The file *myfile* is copied to *yourfile*. Both files are then identical.

CopyFile “HOME:/myfile”, “HOME:/mydir/yourfile”;

The file *myfile* is copied to *yourfile* in directory *mydir.*

Arguments

CopyFile OldPath NewPath

OldPath Data type: *string*

The complete path of the file to be copied from.

NewPath Data type: *string*

The complete path whereto the file is to be copied to.

Program execution

The file specified in *OldPath* will be copied to the file specified in *NewPath*.

Error Handling

If the file specified in *NewPath* already exists, the system variable ERRNO is set to ERR_FILEEXIST. This error can then be handled in the error handler.

Syntax

CopyFile
[OldPath ’:=’] < expression (**IN**) of *string* > ’,’
[NewPath ’:=’] < expression (**IN**) of *string* >’;’

Related information

	Described in:
Opening (etc.) of files	RAPID Summary - Communication

CopyRawBytes - Copy the contents of rawbytes data

CopyRawBytes is used to copy all or part of the contents from one rawbytes variable to another.

Example

```
VAR rawbytes from_raw_data;
VAR rawbytes to_raw_data;
VAR num integer := 8
VAR num float := 13.4;

ClearRawBytes from_raw_data;
PackRawBytes integer, from_raw_data, 1 \IntX := DINT;
PackRawBytes float, from_raw_data, (RawBytesLen(from_raw_data)+1) \Float4;
CopyRawBytes from_raw_data, 1, to_raw_data, 3,
   RawBytesLen(from_raw_data);
```

In this example the variable *from_raw_data* of type *rawbytes* is first cleared, i.e. all bytes set to 0. Then in the first 4 bytes the value of *integer* is placed and in the next 4 bytes the value of *float*.

After having filled *from_raw_data* with data, the contents (8 bytes) is copied to *to_raw_data*, starting at position *3*.

Arguments

CopyRawBytes FromRawData FromIndex ToRawData ToIndex [\NoOfBytes]

FromRawData Data type: *rawbytes*

FromRawData is the data container from which the *rawbytes* data shall be copied.

FromIndex Data type: *num*

FromIndex is the position in *FromRawData* where the data to be copied starts. Indexing starts at 1.

ToRawData Data type: *rawbytes*

ToRawData is the data container to which the *rawbytes* data shall be copied.

ToIndex Data type: *num*

ToIndex is the position in *ToRawData* where the data to be copied will be placed. Indexing starts at 1.

[\NoOfBytes] Data type: *num*

The value specified with \NoOfBytes is the number of bytes to be copied from *FromRawData* to *ToRawData*.

If *\NoOfBytes* is not specified, all bytes from *FromIndex* to the end of current length of valid bytes in *FromRawData* is copied.

Program execution

During program execution data is copied from one *rawbytes* variable to another.

The current length of valid bytes in the *ToRawData* variable is set to:

- (*ToIndex* + copied_number_of_bytes - 1)
- The current length of valid bytes in the *ToRawData* variable is not changed , if the complete copy operation is done inside the old current length of valid bytes in the *ToRawData* variable.

Limitations

CopyRawBytes can not be used to copy some data from one *rawbytes* variable to other part of the same *rawbytes* variable.

Syntax

CopyRawBytes
[FromRawData ':='] < variable (**VAR**) of *rawbytes*> ','
[FromIndex ':='] < expression (**IN**) of *num*> ','
[ToRawData ':='] < variable (**VAR**) of *rawbytes*> ','
[ToIndex ':='] < expression (**IN**) of *num*>
['\'NoOfBytes ':=' < expression (**IN**) of *num*>]';'

Related information

	Described in
rawbytes data	Data Types - rawbytes
Get the length of rawbytes data	Functions - RawBytesLen
Clear the contents of rawbytes data	Instructions - ClearRawBytes
Pack DeviceNet header into rawbytes data	Instructions - PackDNHeader
Pack data into rawbytes data	Instructions - PackRawBytes
Write rawbytes data	Instructions - WriteRawBytes
Read rawbytes data	Instructions - ReadRawBytes
Unpack data from *rawbytes* data	Instructions - *UnpackRawBytes*

CorrClear - Removes all correction generators

Descriptions

CorrClear is used to remove all connected correction generators. The instruction can be used to remove all offsets provided earlier by all correction generators.

Example

CorrClear;

The instruction removes all connected correction generators.

Note!
An easy way to ensure that all correction generators (with corrections) are removed at program start, is to run CorrClear in a START event routine. See System Parameters - Topic: Controller.

Syntax

```
CorrClear ';'
```

Related information

	Described in:
Connects to a correction generator	Instructions - CorrCon
Disconnects from a correction generator	Instructions - CorrDiscon
Writes to a correction generator	Instructions - CorrWrite
Reads the current total offsets	Functions - CorrRead
Correction descriptor	Data types - corrdescr

CorrCon - Connects to a correction generator

CorrCon is used to connect to a correction generator.

Example

```
VAR corrdescr id;
...
CorrCon id;
```

The correction generator reference corresponds to the variable *id* reservation.

Arguments

CorrCon Descr

Descr Data type: *corrdescr*

Descriptor of the correction generator.

Example

Path coordinate system

All path corrections (offsets on the path) are added in the path coordinate system. The path coordinate system is defined as:

P = Path coordinate system
T = Tool coordinate system

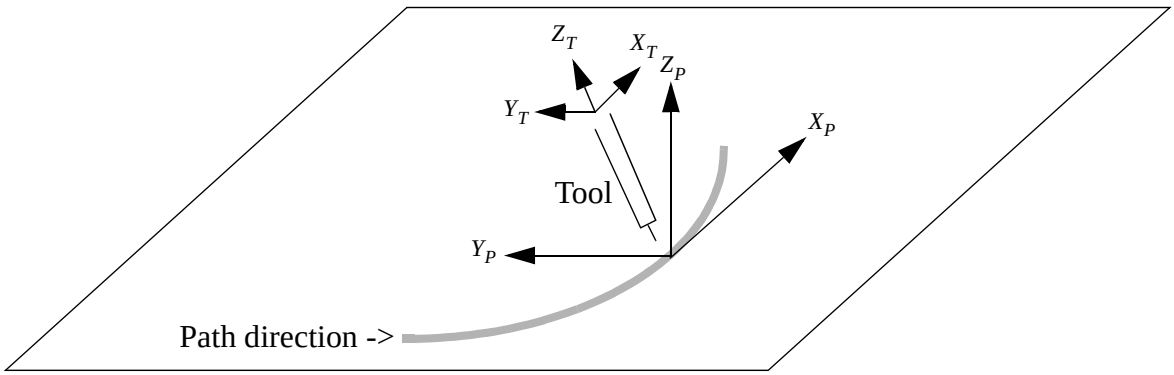


Figure 4 Path coordinate system.

- Path coordinate axis X is given as the tangent of the path.
- Path coordinate axis Y is derived as the cross product of tool coordinate axis Z and path coordinate axis X.
- Path coordinate axis Z is derived as the cross product of path coordinate axis X and path coordinate axis Y.

Application example

An example of an application using path corrections is a robot holding a tool with two sensors mounted on it to detect the vertical and horizontal distances to a work object.

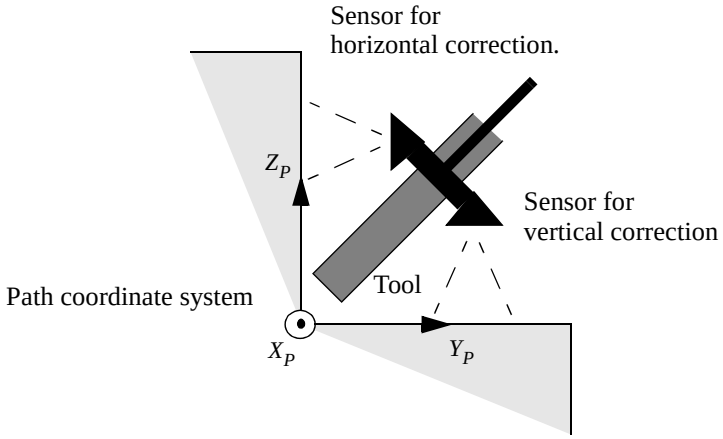


Figure 5 Path correction device.

Program example

```
CONST num TARGET_DIST := 5;
CONST num SCALE_FACTOR := 0.5;
VAR intnum intno1;
VAR corrdesc hori_id:
VAR corrdesc vert_id;
VAR pos total_offset;
VAR signalai hori_sig;
VAR signalai vert_sig;
VAR pos write_offset;
```

```
PROC PathRoutine()

    ! Connect to the correction generators for horizontal and vertical correction.
    CorrCon hori_id;
    CorrCon vert_id;
    ! Setup a 5 Hz timer interrupt. The trap routine will read the sensor values and
    ! compute the path corrections.
    CONNECT intno1 WITH ReadSensors;
    ITimer\singel 0.2, intno1
    ! Position for start of contour tracking
    MoveJ p10,v100,z10,tool1;
    ! Run MoveL with both vertical and horizontal correction.
    MoveL p20,v100,z10,tool1\Corr;
    ! Read the total corrections added by all connected correction generators.
    total_offset := CorrRead();
    ! Write the total vertical correction on the FlexPendant.
    TPWrite “The total vertical correction is: ”\Num:=total_offset.z;
    ! Disconnect the correction generator for vertical correction.
    ! Horizontal corrections will be unaffected.
    CorrDiscon vert_id;
    ! Run MoveL with only horizontalinterrupt correction.
    MoveL p30,v100,z10,tool1\Corr;
    ! Remove all outstanding connected correction generators.
    ! In this case, the only connected correction generator is the one for horizontal
    ! correction.
    CorrClear;
    ! Remove the timer interrupt.
    IDelete intno1;
ENDPROC
```

```
TRAP ReadSensors
   ! Compute the horizontal correction values and execute the correction.
   write_offset.x := 0;
   write_offset.y := (hori_sig - TARGET_DIST)*SCALE_FACTOR;
   write_offset.z := 0;
   CorrWrite hori_id, write_offset;
   ! Compute the vertical correction values and execute the correction.
   write_offset.x := 0;
   write_offset.y := 0;
   write_offset.z := (vert_sig - TARGET_DIST)*SCALE_FACTOR;
   CorrWrite vert_id, write_offset;
   !Setup interrupt again
   IDelete intnol;
   CONNECT intno1 WITH ReadSensors;
   ITimer\singel 0.2, intno1;
ENDTRAP
```

Program explanation

Two correction generators are connected with the instruction *CorrCon*. Each correction generator is referenced by a unique descriptor (*hori_id* and *vert_id*) of the type *corrdesc*. The two sensors will use one correction generator each.

A timer interrupt is set up to call the trap routine *ReadSensors* with a frequency of 5 Hz. The offsets, needed for path correction, are computed in the trap routine and written to the corresponding correction generator (referenced by the descriptors *hori_id* and *vert_id*) by the instruction *CorrWrite*. All the corrections will have immediate effect on the path.

The *MoveL* instruction must be programmed with the switch argument *Corr* when path corrections are used. Otherwise, no corrections will be executed.

When the first *MoveL* instruction is ready, the function *CorrRead* is used to read the sum of all the corrections (the total path correction) given by all the connected correction generators. The result of the total vertical path correction is written to the FlexPendant with the instruction *TPWrite*.

CorrDiscon will then disconnect the correction generator for vertical correction (referenced by the descriptor *vert_id*). All corrections added by this correction generator will be removed from the total path correction. The corrections added by the correction generator for horizontal correction will still be preserved.

Finally, the function *CorrClear* will remove all outstanding connected correction generators and their previously added corrections. In this case, it is only the correction generator for horizontal correction that will be removed. The timer interrupt will also be removed by the instruction *IDelete*.

The correction generators

x	y	z	
			Path coordinate axis.
0	0	3	Vertical correction generator, with the sum of all its own path corrections.
0	1	0	Horizontal correction generator, with the sum of all its own path corrections.
-	-	-	Not connected correction generator.
-	-	-	Not connected correction generator.
-	-	-	Not connected correction generator.
0	1	3	The sum of all corrections done by all connected correction generators.

Figure 6 Correction generators.

Limitations

A maximum number of 5 correction generators can be connected simultaneously.

Syntax

CorrCon
[Descr ':='] < variable **(VAR)** of *corrdescr* > ';'

Related information

	Described in:
Disconnects from a correction generator	Instructions - CorrDiscon
Writes to a correction generator	Instructions - CorrWrite
Reads the current total offsets	Functions - CorrRead
Removes all correction generators	Instructions - CorrClear
Correction generator descriptor	Data types - corrdescr

CorrDiscon - Disconnects from a correction generator

Description

CorrDiscon is used to disconnect from a previously connected correction generator. The instruction can be used to remove corrections given earlier.

Example

```
VAR corrdescr id;
...
CorrCon id;
...
CorrDiscon id;
```

CorrDiscon disconnects from the previously connected correction generator referenced by the descriptor id.

Arguments

CorrDiscon Descr

Descr Data type: corrdescr

Descriptor of the correction generator.

Example

See Instructions - *CorrCon*

Syntax

```
CorrDiscon
   [ Descr ':=' ] < variable (VAR) of corrdescr > ';'
```

Related information

	Described in:
Connects to a correction generator	Instructions - CorrCon
Writes to a correction generator	Instructions - CorrWrite
Reads the current total offsets	Functions - CorrRead
Removes all correction generators	Instructions - CorrClear
Correction descriptor	Data types - corrdescr

CorrWrite - Writes to a correction generator

Description

CorrWrite is used to write offsets in the path coordinate system to a correction generator.

Example

```
VAR corrdescr id;
VAR pos offset;
...
CorrWrite id, offset;
```

The current offsets, stored in the variable offset, are written to the correction generator referenced by the descriptor id.

Arguments

CorrWrite Descr Data

Descr — Data type: corrdescr

Descriptor of the correction generator.

Data — Data type: pos

The offset to be written.

Example

See Instructions - CorrCon

Limitations

The best performance is achieved on straight paths. As the speed and angles between to consecutive linear paths increase, the deviation from the expected path will also increase. The same applies to circles with decreasing circle radius.

Syntax

```
CorrWrite
  [ Descr ':=' ] < variable (VAR) of corrdescr > ','
  [ Data ':=' ] < expression (IN) of pos > ';'
```

Related information

	Described in:
Connects to a correction generator	Instructions - CorrCon
Disconnects from a correction generator	Instructions - CorrDiscon
Reads the current total offsets	Functions - CorrRead
Removes all correction generators	Instructions - CorrClear
Correction generator descriptor	Data types - corrdescr

DeactUnit - Deactivates a mechanical unit

DeactUnit is used to deactivate a mechanical unit.

It can be used to determine which unit is to be active when, for example, common drive units are used.

This instruction can only be used in the *Main* task or, if in a MultiMove System, in Motion tasks.

Examples

```
DeactUnit orbit_a;
```

Deactivation of the *orbit_a* mechanical unit.

```
MoveL p10, v100, fine, tool1;
DeactUnit track_motion;
MoveL p20, v100, z10, tool1;
MoveL p30, v100, fine, tool1;
ActUnit track_motion;
MoveL p40, v100, z10, tool1;
```

The unit *track_motion* will be stationary when the robot moves to *p20* and *p30*. After this, both the robot and *track_motion* will move to *p40*.

```
MoveL p10, v100, fine, tool1;
DeactUnit orbit1;
ActUnit orbit2;
MoveL p20, v100, z10, tool1;
```

The unit *orbit1* is deactivated and *orbit2* activated.

Arguments

DeactUnit **MechUnit**

MechUnit *(Mechanical Unit)* Data type: *mecunit*

The name of the mechanical unit that is to be deactivated.

Program execution

When the robot and external axes have come to a standstill, the specified mechanical unit is deactivated. This means that it will neither be controlled nor monitored until it is re-activated.

If several mechanical units share a common drive unit, deactivation of one of the mechanical units will also disconnect that unit from the common drive unit.

Limitations

Instruction DeactUnit cannot be used

- in program sequence StorePath ... RestoPath
- in event routine RESTART
- when one of the axes in the mechanical unit is in independent mode.

Syntax

DeactUnit
[MechUnit ':='] < variable (VAR) of *mecunit*> **';'**

Related information

	Described in:
Activating mechanical units	Instructions - ActUnit
Mechanical units	Data Types - mecunit

Decr - Decrements by 1

Decr is used to subtract 1 from a numeric variable or persistent.

Example

Decr reg1;

1 is subtracted from *reg1*, i.e. reg1:=reg1-1.

Arguments

Decr Name

Name Data type: *num*

The name of the variable or persistent to be decremented.

Example

```
TPReadNum no_of_parts, "How many parts should be produced? ";
WHILE no_of_parts>0 DO
   produce_part;
   Decr no_of_parts;
ENDWHILE
```

The operator is asked to input the number of parts to be produced. The variable *no_of_parts* is used to count the number that still have to be produced.

Syntax

Decr
[Name ':='] < var or pers (**INOUT**) of *num* > ';'

Related information

	Described in:
Incrementing a variable by 1	Instructions - Incr
Subtracting any value from a variable	Instructions - Add
Changing data using an arbitrary	Instructions - := expression, e.g. multiplication

DitherAct - Enables dither for soft servo

DitherAct is used to enable the dither functionality, which will reduce the friction in soft servo for IRB 7600.

This instruction can only be used in the *Main* task or, if in a MultiMove System, in Motion tasks.

Examples

```
SoftAct \MechUnit:=ROB_1, 2, 100;
WaitTime 2;
DitherAct \MechUnit:=ROB_1, 2;
WaitTime 1;
DitherDeact;
SoftDeact;
```

Dither is enabled only for one second while in soft servo.

```
DitherAct \MechUnit:=ROB_1, 2;
SoftAct \MechUnit:=ROB_1, 2, 100;
WaitTime 1;
MoveL p1, v50, z20, tool1;
SoftDeact;
DitherDeact;
```

Dither is enabled for axis 2. Movement is delayed one second to allow sufficient transition time for the SoftAct ramp. If *DitherAct* is called before *SoftAct*, dither will start whenever a *SoftAct* is executed for that axis. If no *DitherDeact* is called, dither will stay enabled for all subsequent *SoftAct* calls.

Arguments

DitherAct **[\MechUnit] Axis [\Level]**

[\MechUnit] *(Mechanical Unit)* Data type: *mecunit*

The name of the mechanical unit. If argument is omitted, it means activation of the soft servo for specified robot axis.

Axis Data type: *num*

Axis number (1-6).

[\Level] Data type: *num*

Amplitude of dither (50-150%). At 50%, oscillations are reduced (increased friction). At 150%, amplitude is maximum (may result in vibrations of endeffector). The default value is 100%.

Program execution

DitherAct can be called before, or after *SoftAct*. Calling *DitherAct* after *SoftAct* is faster, but has other limitations.

Dither is usually not required for axis 1 of IRB 7600. Highest effect of friction reduction is on axes 2 and 3.

Dither parameters are self-adjusting. Full dither performance is achieved after three or four executions of SoftAct in process position.

Limitations

Calling *DitherAct* after *SoftAct* may cause unwanted movement of the robot.The only way to eliminate this behaviour is to call *DitherAct* before *SoftAct*. If there still is movement, *SoftAct* ramp time should be encreased.

However, when calling *DitherAct* before *SoftAct* the robot **must be in a fine point**. Also, **leaving the fine point is not permitted** until the transition time of the ramp is over. **This might damage the gear boxes**.

The transition time is the ramp time, which varies between robots, multiplied with the ramp factor of the SoftAct-instruction.

Dithering is not available for axis 6.

Dither is always deactivated when there is a power failure.

The instruction is only to be used for IRB 7600.

Syntax

DitherAct
[’\’ MechUnit ’:=’ < variable (**VAR**) of *mecunit* >]
[Axis ’:=’] < expression (**IN**) of *num* >
[’\’ Level ‘:=’ < expression (**IN**) of *num* >] ’;’

Related information

	Described in:
Activating Soft Servo	Instructions - SoftAct
Get robot name in current task	Functions - RobName
Behaviour with the soft servo engaged	Motion and I/O Principles - Positioning during program execution
Disable of dither instructions	Instructions - DitherDeact

DitherDeact - Disables dither for soft servo

DitherDeact is used to disable the dither functionality for soft servo of IRB 7600.

This instruction can only be used in the *Main* task or, if in a MultiMove System, in Motion tasks.

Examples

DitherDeact;

Deactivates dither on all axis.

Program execution

DitherDeact can be used at any time. If in soft servo, dither stops immediatley on all axis. If not in soft servo, dither will not be active when next *SoftAct* is executed.

Syntax

DitherDeact ‘;’

Related information

	Described in:
Activating dither	Instructions - DitherAct

DropSensor - Drop object on sensor

DropSensor (Drop Sensor) is used to disconnect from the current object and the program is ready for the next.

Example

```
MoveL *, v1000, z10, tool, \WObj:=wobj0;
SyncToSensor Ssync1\Off;
MoveL *, v1000, fine, tool, \WObj:=wobj0;
DropSensor Ssync1;
MoveL *, v1000, z10, tool, \WObj:=wobj0;
```

Arguments

DropSensor Mecunt

Mecunt *(Mechanical Unit)* Data type: *mecunit*

The moving mechanical unit to which the robot position in the instruction is related.

Program execution

Dropping the object means that the encoder unit not longer tracks the object. The object is removed from the object queue and cannot be recovered.

Limitations

If the instruction is issued while the robot is actively using the sensor object then the motion stops. The instruction must be issued after the robot has passed the last synchronized robtarget .

The instruction may be issued only after a non synchronized movement has been used in the preceeding motion instructions with either a fine point or several (>1) corner zones.

Syntax

DropSensor
[Mecunt':='] < persistent (PERS) of *mecunit*> **';**

Related information

	Described in:
Wait for connection on sensor	Instructions - WaitSensor
Sync to sensor	Instructions - SyncToSensor

DropWObj - Drop work object on conveyor

DropWObj (Drop Work Object) is used to disconnect from the current object and the program is ready for the next.

Example

MoveL *, v1000, z10, tool, \WObj:=wobj_on_cnv1;

MoveL *, v1000, fine, tool, \WObj:=wobj0;

DropWObj wobj_on_cnv1;

MoveL *, v1000, z10, tool, \WObj:=wobj0;

Arguments

DropWObj WObj

WObj *(Work Object)* Data type: *wobjdata*

The moving work object (coordinate system) to which the robot position in the instruction is related. The mechanical unit conveyor is to be specified by the *ufmec* in the work object.

Program execution

Dropping the work object means that the encoder unit not longer tracks the object. The object is removed from the object queue and cannot be recovered.

Limitations

If the instruction is issued while the robot is actively using the conveyor coordinated work object then the motion stops.

The instruction may be issued only after a fixed work object has been used in the preceding motion instructions with either a fine point or several (>1) corner zones.

Syntax

DropWObj
[WObj ':='] < persistent (PERS) of wobjdata> ';'

EOffsOff - Deactivates an offset for external axes

EOffsOff (External Offset Off) is used to deactivate an offset for external axes.

The offset for external axes is activated by the instruction *EOffsSet* or *EOffsOn* and applies to all movements until some other offset for external axes is activated or until the offset for external axes is deactivated.

This instruction can only be used in the *Main* task or, if in a MultiMove System, in Motion tasks.

Examples

```
EOffsOff;
```

Deactivation of the offset for external axes.

```
MoveL p10, v500, z10, tool1;
EOffsOn \ExeP:=p10, p11;
MoveL p20, v500, z10, tool1;
MoveL p30, v500, z10, tool1;
EOffsOff;
MoveL p40, v500, z10, tool1;
```

An offset is defined as the difference between the position of each axis at *p10* and *p11*. This displacement affects the movement to *p20* and *p30,* but not to *p40*.

Program execution

Active offsets for external axes are reset.

Syntax

EOffsOff ‘;’

Related information

	Described in:
Definition of offset using two positions	Instructions - EOffsOn
Definition of offset using values	Instructions - EOffsSet
Deactivation of the robot's motion displacement	Instructions - PDispOff

EOffsOn - Activates an offset for external axes

EOffsOn (External Offset On) is used to define and activate an offset for external axes using two positions.

This instruction can only be used in the *Main* task or, if in a MultiMove System, in Motion tasks.

Examples

```
MoveL p10, v500, z10, tool1;
EOffsOn \ExeP:=p10, p20;
```

Activation of an offset for external axes. This is calculated for each axis based on the difference between positions *p10* and *p20*.

```
MoveL p10, v500, fine \Inpos := inpos50, tool1;
EOffsOn *;
```

Activation of an offset for external axes. Since a stop point that is accurately defined has been used in the previous instruction, the argument *\ExeP* does not have to be used. The displacement is calculated on the basis of the difference between the actual position of each axis and the programmed point (*) stored in the instruction.

Arguments

EOffsOn **[\ExeP] ProgPoint**

[\ExeP] *(Executed Point)* Data type: *robtarget*

The new position of the axes at the time of the program execution. If this argument is omitted, the current position of the axes at the time of the program execution is used.

ProgPoint *(Programmed Point)* Data type: *robtarget*

The original position of the axes at the time of programming.

Program execution

The offset is calculated as the difference between *ExeP* and *ProgPoint* for each separate external axis. If *ExeP* has not been specified, the current position of the axes at the time of the program execution is used instead. Since it is the actual position of the axes that is used, the axes should not move when *EOffsOn* is executed.

This offset is then used to displace the position of external axes in subsequent positioning instructions and remains active until some other offset is activated (the instruction *EOffsSet* or *EOffsOn*) or until the offset for external axes is deactivated (the instruction *EOffsOff*).

Only one offset for each individual external axis can be activated at any one time. Several *EOffsOn*, on the other hand, can be programmed one after the other and, if they are, the different offsets will be added.

The external axes' offset is automatically reset

- at a cold start-up
- when a new program is loaded
- when starting program executing from the beginning.

Example

```
SearchL sen1, psearch, p10, v100, tool1;
PDispOn \ExeP:=psearch, *, tool1;
EOffsOn \ExeP:=psearch, *;
```

A search is carried out in which the searched position of both the robot and the external axes is stored in the position *psearch*. Any movement carried out after this starts from this position using a program displacement of both the robot and the external axes. This is calculated based on the difference between the searched position and the programmed point (*) stored in the instruction.

Syntax

EOffsOn
['\' ExeP ':=' < **expression (IN) of** *robtarget* **> ',']**
[ProgPoint ':='] < **expression (IN) of** *robtarget* **> ';'**

Related information

	Described in:
Deactivation of offset for external axes	Instructions - EOffsOff
Definition of offset using values	Instructions - EOffsSet
Displacement of the robot's movements	Instructions - PDispOn
Coordinate Systems	Motion Principles- Coordinate Systems

EOffsSet - Activates an offset for external axes using a value

EOffsSet (External Offset Set) is used to define and activate an offset for external axes using values.

This instruction can only be used in the *Main* task or, if in a MultiMove System, in Motion tasks.

Example

```
VAR extjoint eax_a_p100 := [100, 0, 0, 0, 0, 0];
.
EOffsSet eax_a_p100;
```

Activation of an offset *eax_a_p100* for external axes, meaning (provided that the external axis “a” is linear) that:

- The ExtOffs coordinate system is displaced 100 mm for the logical axis “a” (see Figure 7).
- As long as this offset is active, all positions will be displaced 100 mm in the direction of the x-axis.

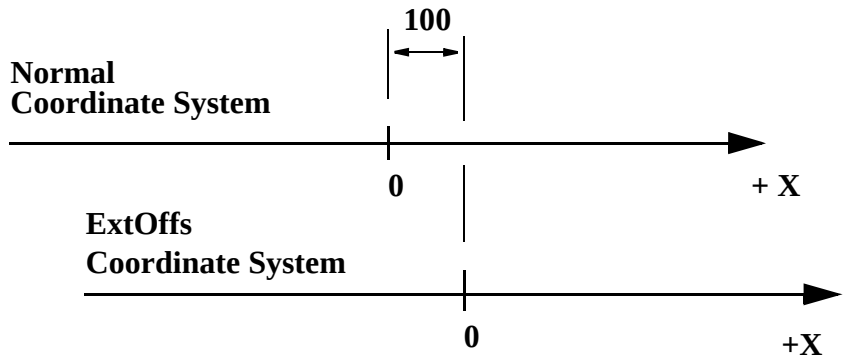


Figure 7 Displacement of an external axis.

Arguments

EOffsSet **EAxOffs**

EAxOffs *(External Axes Offset)* Data type: *extjoint*

The offset for external axes is defined as data of the type *extjoint*, expressed in:

- mm for linear axes
- degrees for rotating axes

Program execution

The offset for external axes is activated when the *EOffsSet* instruction is activated and remains active until some other offset is activated (the instruction *EOffsSet* or *EOffsOn*) or until the offset for external axes is deactivated (the *EOffsOff*).

Only one offset for external axes can be activated at any one time. Offsets cannot be added to one another using *EOffsSet*.

The external axes' offset is automatically reset

- at a cold start-up
- when a new program is loaded
- when starting program executing from the beginning.

Syntax

EOffsSet
[EAxOffs ':='] < expression (IN) of *extjoint*> **';'**

Related information

	Described in:
Deactivation of offset for external axes	Instructions - EOffsOff
Definition of offset using two positions	Instructions - EOffsSet
Displacement of the robot's movements	Instructions - PDispOn
Definition of data of the type extjoint	Data Types - extjoint
Coordinate Systems	Motion Principles- Coordinate Systems

EraseModule - Erase a module

EraseModule is used to remove a module from the program memory during execution.

There are no restrictions on how the module was loaded. It could have been loaded manually, from the configuration or with the instruction set “Load/StartLoad/WaitLoad”

The only requirement is that it was not specified as “shared” in the configuration.

Example

```
EraseModule "PART_A";
```

Erase the program module PART_A from the program memory.

Arguments

```
EraseModule ModuleName
```

ModuleName Data type: *string*

The name of the module that should be removed. Please note that this is the name of the module, not the name of the file.

Program execution

The program execution waits for the program module to finish the removal process before the execution proceeds with the next instruction.

When the program module is removed the rest of the program modules will be linked.

Limitations

It is not allowed to remove a program module that is executing.

TRAP routines, system I/O events and other program tasks cannot execute during the removal process.

Avoid ongoing robot movements during the removal.

Program stop during execution of *EraseModule* instruction results in guard stop with motors off and error message "20025 Stop order timeout" on the Flex Pendant.

Error handling

If the file in the *EraseModule* instruction cannot be removed because it was not found, the system variable ERRNO is set to ERR_MODULE. This error can then be handled in the error handler.

Syntax

EraseModule
[ModuleName':=']<expression (**IN**) of *string*>';'

Related information

	Described in:
Unload a program module	Instructions - UnLoad
Load a program module in parallel	Instructions - StartLoad-WaitLoad with another program execution
Accept unresolved reference	System Parameters - Controller /Tasks / BindRef

ErrLog - Write an error message

ErrLog is used to display an error message on the FlexPendant and write it in the robot message log. Error number and five error arguments must be stated.

Example

An *ErrorId* must be declared in a .xml file. The number must be between 5000 - 9999. The error message is written in the .xml file and the arguments to the message is sent in by the *ErrLog* instruction.The *ErrorId* in the .xml file is the same stated in the *ErrLog* instruction.

Example of message in .xml file:

```
<Message number="5210" eDefine="SYS_ERR_ARL_INPAR_RDONLY">
        <Title>Parameter error</Title>
        <Description>Task:<arg format="%.16s" ordinal="1" />
          <p />Symbol <arg format="%.16s" ordinal="2" />is read-only
          <p />Context:<arg format="%.40s" ordinal="3" /><p />
        </Description>
</Message>
```

Example of instruction:

```
MODULE MyModule
        PROC main
          {
            VAR num errorid := 5210;
            VAR errstr arg := “P1”;
            ErrLog errorid, ERRSTR_TASK, arg, ERRSTR_CONTEXT,
                                              ERRSTR_UNUSED,
  ERRSTR_UNUSED;
            ErrLog errorid \W, ERRSTR_TASK, arg, ERRSTR_CONTEXT,
                                              ERRSTR_UNUSED,
  ERRSTR_UNUSED;
          }
        ENDPROC
ENDMODULE
```

On the FlexPendant the message will look like this:

```
Event Message: 5210
Parameter error
Task: main
Symbol P1 is read-only.
Context: MyModule/main/ErrLog
```

The first *ErrLog* instruction generates an error message. The message is stored in the robot log, in the process domain. It is also shown on the FlexPendant display.

The second instruction is a warning. A message is stored in the robot log only.

The program will continue its execution when the instruction is done.

In case you do not want to make your own .xml file, you can use ErrorId 4800 like in the example below:

```
VAR errstr my_title := “myerror”;
VAR errstr str1 := “errortext1”;
VAR errstr str2 := “errortext2”;
VAR errstr str3 := “errortext3”;
VAR errstr str4 := “errortext4”;

ErrLog 4800, my_title, str1,str2,str3,str4;
```

On the FlexPendant the message will look like this:

```
Event Message: 4800
myerror
errortext1
errortext2
errortext3
errortext4
```

Arguments

ErrLog ErrorID [\W] Argument1 Argument2 Argument3

Argument4 Argument5

ErrorId Data type: *num*

The number of a specific error that is to be monitored.
The error number must be in interval 5000 - 9999 and written in a xml file.

[\W] *(Warning)* Data type: *switch*

Gives a warning that is stored in the robot error message log only (not shown directly on the FlexPendant display).

Argument Data type: *errstr*

First argument in the error message.
Any string or predefined data of type *errstr* can be used.

Argument2 Data type: *errstr*

Second argument in the error message.
Any string or predefined data of type *errstr* can be used.

Argument3 Data type: *errstr*

Third argument in the error message.
Any string or predefined data of type *errstr* can be used

Argument4 Data type: *errstr*

Fourth argument in the error message.
Any string or predefined data of type *errstr* can be used.

Argument5 Data type: *errstr*

Fifth argument in the error message.
Any string or predefined data of type *errstr* can be used.

Program execution

An error message (max 5 lines) is displayed on the FlexPendant and written in the robot message log.

ErrLog generates program errors between 5000 - 9999 depending on the *ErrorId* indicated.

Syntax

ErrLog
[ErrorId ':='] < expression (**IN**) of *num*> ','
['\' W ',']
[Argument1 ':='] < expression (**IN**) of *errstr*> ','
[Argument2 ':='] < expression (**IN**) of *errstr*> ','
[Argument3 ':='] < expression (**IN**) of *errstr*> ','
[Argument4 ':='] < expression (**IN**) of *errstr*> ','
[Argument5 ':='] < expression (**IN**) of *errstr*> ','

Related information

	Described in:
Display a message on	Instructions - TPWrite the FlexPendant only
Message logs	Service

ErrRaise - Writes a warning and calls an error handler

ErrRaise is used to create an error in the program and then call the error handler of the routine. A warning is written in the robot message log. *ErrRaise* can also be used in the error handler to propagate the current error to the error handler of the calling routine.

Error name, error number and five error arguments must be stated.

Example

An *ErrorId* must be declared in a .xml file. The number must be between 5000 - 9999. The error message is written in the .xml file and the arguments to the message is sent in by the *ErrRaise* instruction. The *ErrorId* in the .xml file is the same stated in the *ErrRaise* instruction.

Example of message in .xml file:

```
<Message number="7055" eDefine="SYS_ERR_ARL_INPAR_RDONLY">
                <Title>Parameter error</Title>
                <Description>Task:<arg format="%.16s" ordinal="1" />
                   <p />Symbol <arg format="%.16s" ordinal="2" />is read-only
                   <p />Context:<arg format="%.40s" ordinal="3" /><p /></Descrip-
   tion>
</Message>
```

Example of instruction:

```
MODULE MyModule
                PROC main
                   {
                      VAR errnum ERR_BATT:= -1;
                      VAR num errorid := 7055;
                      BookErrNo ERR_BATT;
                      ErrRaise "ERR_BATT", errorid, ERRSTR_TASK,
   ERRSTR_CONTEXT,
                                                        ERRSTR_UNUSED,
   ERRSTR_UNUSED, ERRSTR_UNUSED;
                      ERROR
                      IF ERRNO = ERR_BATT
                                                        .....
                                                        TRYNEXT;
                   }
                ENDPROC
ENDMODULE
```

On the FlexPendant the message will look like this (warning or/and an error):

Event Message: 7055
Backup battery status
Task: main
Backup battery is fully charged
Context: MyModule/main/ErrRaise

An error number must be booked with the instruction *BookErrNo*. Corresponding string is stated as the first argument, *ErrorName,* in the *ErrRaise*.

ErrRaise creates an error and then calls the error handler. If the error is taken care of a warning is generated in the event log, in the process domain, otherwise a fatal error is generated and the program stops.

ErrRaise can also be used in an error handler in a subroutine. In this case the execution continues in the error handler of the calling routine.

Arguments

ErrRaise **ErrorName ErrorID Argument1 Argument2 Argument3 Argument4 Argument5**

ErrorName Data type: *string*

An error number must be booked using the instruction *BookErrNo*. Corresponding string is stated as *ErrorName*.

ErrorId Data type: *num*

The number of a specific error that is to be monitored. The error number must be in interval 5000 - 9999 and written in a xml file.

Argument1 Data type: *errstr*

First argument in the error message.
Any string or predefined data of type *errstr* can be used.

Argument2 Data type: *errstr*

Second argument in the error message.
Any string or predefined data of type *errstr* can be used.

Argument3 Data type: *errstr*

Third argument in the error message.
Any string or predefined data of type *errstr* can be used

Argument4 Data type: *errstr*

Fourth argument in the error message.
Any string or predefined data of type *errstr* can be used.

Argument5 Data type: *errstr*

Fifth argument in the error message.
Any string or predefined data of type *errstr* can be used.

Program execution

Program execution continues in the error handler of the routine. A warning is written in the robot message log. In which domain depends on the *EventDomain* indicated.

ErrRaise generates program warnings between 5000 - 9999 depending on the *ErrorId* indicated.

After the error handler has been executed, program execution can continue with:

- the routine that called the routine in question
- the error handler of the routine that called the routine in question

If the *ErrRaise* instruction is present in a routine's error handler, program execution continues in the error handler of the routine that called the routine in question. The same error number remains active.

Syntax

ErrRaise
[ErrorName ':='] < expression (**IN**) of *string*> ','
[ErrorId ':='] < expression (**IN**) of *num*> ','
[Argument1 ':='] < expression (**IN**) of *errstr*> ','
[Argument2 ':='] < expression (**IN**) of *errstr*> ','
[Argument3 ':='] < expression (**IN**) of *errstr*> ','
[Argument4 ':='] < expression (**IN**) of *errstr*> ','
[Argument5 ':='] < expression (**IN**) of *errstr*> ','

Related information

	Described in:
Error handling	Basic Characteristics - Error Recovery
Booking error numbers	Instructions - BookErrNo

ErrWrite - Write an error message

ErrWrite (Error Write) is used to display an error message on the FlexPendant and write it in the robot message log.

Example

```
ErrWrite “PLC error”, “Fatal error in PLC” \RL2:=”Call service”;
Stop;
```

A message is stored in the robot log. The message is also shown on the FlexPendant display.

```
ErrWrite \ W, “ Search error”, “No hit for the first search”;
RAISE try_search_again;
```

A message is stored in the robot log only. Program execution then continues.

Arguments

ErrWrite [\W] Header Reason [\RL2] [\RL3] [\RL4]

[\W] *(Warning)* Data type: *switch*

Gives a warning that is stored in the robot error message log only (not shown directly on the FlexPendant display).

Header Data type: *string*

Error message heading (max. 24 characters).

Reason Data type: string

Reason for error (line 1 of max. 40 characters).

[\RL2] *(Reason Line 2)* Data type: *string*

Reason for error (line 2 of max. 40 characters).

[\RL3] *(Reason Line 3)* Data type: *string*

Reason for error (line 3 of max. 40 characters).

[\RL4] *(Reason Line 4)* Data type: *string*

Reason for error (line 4 of max. 40 characters).

Program execution

An error message (max. 5 lines) is displayed on the FlexPendant and written in the robot message log.

ErrWrite always generates the program error no. 80001 or in the event of a warning (argument \W) generates no. 80002.

Limitations

Total string length (Header+Reason+\RL2+\RL3+\RL4) is limited to 145 characters.

Syntax

ErrWrite
[’\’ W ’,’]
[Header ’:=’] < expression (**IN**) of *string*> ‘,’
[Reason ’:=’] < expression (**IN**) of *string*>
[’\’ RL2 ’:=’ < expression (**IN**) of *string*>]
[’\’ RL3 ’:=’ < expression (**IN**) of *string*>]
[’\’ RL4 ’:=’ < expression (**IN**) of *string*>] ‘;’

Related information

	Described in:
Display a message on	Instructions - TPWrite the FlexPendant only
Message logs	Service

EXIT - Terminates program execution

EXIT is used to terminate program execution. Program restart will then be blocked, i.e. the program can only be restarted from the first instruction of the main routine (if the start point is not moved manually).

The *EXIT* instruction should be used when fatal errors occur or when program execution is to be stopped permanently. The *Stop* instruction is used to temporarily stop program execution.

Example

```
ErrWrite "Fatal error","Illegal state";
EXIT;
```

Program execution stops and cannot be restarted from that position in the program.

Syntax

EXIT ';'

Related information

	Described in:
Stopping program execution temporarily	Instructions - Stop

ExitCycle - Break current cycle and start next

ExitCycle is used to break the current cycle and move the PP back to the first instruction in the main routine.

If the program is executed in continuous mode, it will start to execute the next cycle.

If the execution is in cycle mode, the execution will stop at the first instruction in the main routine.

Example

```
VAR num cyclecount:=0;
VAR intnum error_intno;

PROC main()
   IF cyclecount = 0 THEN
      CONNECT error_intno WITH error_trap;
      ISignalDI di_error,1,error_intno;
   ENDIF
   cyclecount:=cyclecount+1;
   ! start to do something intelligent
   ....

ENDPROC

TRAP error_trap
   TPWrite “ERROR, I will start on the next item”;
   ExitCycle;
ENDTRAP
```

This will start the next cycle if the signal *di_error* **is set.**

Program execution

Execution of *ExitCycle* in a program task controlling mechanical units, results in the following in the MAIN task:

- On-going robot movements stops
- All robot paths that are not performed at all path levels (both normal and *StorePath* level) are cleared
- All instructions that are started but not finished at all execution levels (both normal and TRAP level) are interrupted
- The program pointer is moved to the first instruction in the main routine
- The program execution continues to execute the next cycle

Execution of *ExitCycle* in some other program task, not controlling mechanical units, results in the following in the actual task:

- All instructions that are started but not finished on all execution levels (both normal and TRAP level) are interrupted
- The program pointer is moved to the first instruction in the main routine
- The program execution continues to execute the next cycle

All other modal things in the program and system are **not** affected by *ExitCycle* such as:

- The actual value of variables or persistents
- Any motion settings such as *StorePath-RestoPath* sequence, world zones, etc.
- Open files, directories, etc.
- Defined interrupts, etc.

When using *ExitCycle* in routine calls and the entry routine is defined with “Move PP to Routine ...” or “Call Routine ...”, *ExitCycle* breaks the current cycle and moves the PP back to the first instruction in the entry routine (instead of the main routine as specified above).

Syntax

ExitCycle’;’

Related information

	Described in:
Stopping after a fatal error	Instructions - EXIT
Terminating program execution	Instructions - EXIT
Stopping for program actions	Instructions - Stop
Finishing execution of a routine	Instructions - RETURN

FOR - Repeats a given number of times

FOR is used when one or several instructions are to be repeated a number of times.

Example

```
FOR i FROM 1 TO 10 DO
   routine1;
ENDFOR
```

Repeats the *routine1* procedure *10* times.

Arguments

FOR Loop counter FROM Start value TO End value [STEP Step value] DO ... ENDFOR

Loop counter Identifier

The name of the data that will contain the value of the current loop counter. The data is declared automatically.

If the loop counter name is the same as any data that already exists in the actual scope, the existing data will be hidden in the FOR loop and not affected in any way.

Start value Data type: *Num*

The desired start value of the loop counter.
(usually integer values)

End value Data type: *Num*

The desired end value of the loop counter.
(usually integer values)

Step value Data type: *Num*

The value by which the loop counter is to be incremented (or decremented) each loop.
(usually integer values)

If this value is not specified, the step value will automatically be set to 1 (or -1 if the start value is greater than the end value).

Example

```
FOR i FROM 10 TO 2 STEP -1 DO
   a{i} := a{i-1};
ENDFOR
```

The values in an array are adjusted upwards so that a{10}:=a{9}, a{9}:=a{8} etc.

Program execution

1. The expressions for the start, end, and step values are evaluated.
2. The loop counter is assigned the start value.
3. The value of the loop counter is checked to see whether its value lies between the start and end value, or whether it is equal to the start or end value. If the value of the loop counter is outside of this range, the FOR loop stops and program execution continues with the instruction following ENDFOR.
4. The instructions in the FOR loop are executed.
5. The loop counter is incremented (or decremented) in accordance with the step value.
6. The FOR loop is repeated, starting from point 3.

Limitations

The loop counter (of data type *num*) can only be accessed from within the FOR loop and consequently hides other data and routines that have the same name. It can only be read (not updated) by the instructions in the FOR loop.

Decimal values for start, end or stop values, in combination with exact termination conditions for the FOR loop, cannot be used (undefined whether or not the last loop is running).

Remarks

If the number of repetitions is to be repeated as long as a given expression is evaluated to a *TRUE* value, the *WHILE* instructions should be used instead.

Syntax

(EBNF)
FOR <loop variable> **FROM** <expression> **TO** <expression>
[**STEP** <expression>] **DO**
<instruction list>
ENDFOR
<loop variable> ::= <identifier>

Related information

	Described in:
Expressions	Basic Characteristics - Expressions
Repeats as long as...	Instructions - WHILE
Identifiers	Basic Characteristics - Basic Elements

GetDataVal - Get the value of a data object

GetDataVal (Get Data Value) makes it possible to get a value from a data object that is specified with a string variable.

Example

```
VAR num value;
...
GetDataVal “reg”+ValToStr(ReadNum(mycom)),value;
```

This will get the value of a register, the number of which is received from the serial channel *mycom***. The value will be stored in the variable** *value***.**

```
VAR datapos block;
VAR string name;
VAR num valuevar;
...
SetDataSearch “num” \Object:=”my.*” \InMod:=”mymod”;
WHILE GetNextSym(name,block) DO
   GetDataVal name\Block:=block,valuevar;
   TPWrite name+" "\Num:=valuevar;
ENDWHILE
```

This session will print out all num variables that begin with *my* **in the module** *mymod* **with its value to the FlexPendant.**

Arguments

GetDataVal Object [\Block] Value

Object Data type: *string*

The name of the data object.

[\Block] Data type: *datapos*

The enclosed block to the data object. This can only be fetched with the *GetNextSym* function.

If this argument is omitted, the value of the visible data object in the current program execution scope will be fetched. No array data objects will be found.

Value Data type: *anytype*

Variable for storage of the get value. The data type must be the same as the data type for the data object to find. The get value can be fetched from a constant, variable or persistent, but must be stored in a variable.

Error handling

The system variable ERRNO is set to ERR_SYM_ACCESS if:

- the data object is non-existent
- the data object is routine data or routine parameter and not located in the current active routine

The error can be handled in the error handler of the routine.

Limitations

Array data objects cannot be defined in the symbol search set and cannot be found in a search sequence.

For a semivalue data type, it is not possible to search for the associated value data type. E.g. if searching for *dionum*, no search hit for signals *signaldi* will be obtained and if searching for num, no search hit for signals *signalgi* or *signalai* will be obtained.

It is not possible to get the value of a variable declared as LOCAL in a built in RAPID module.

Syntax

GetDataVal
[Object ':='] < expression (**IN**) of *string* >
['\'Block ':='<variable (**VAR**) of *datapos*>] ','
[Value ':='] <variable (**VAR**) of *anytype*>]';'

Related information

	Described in:
Define a symbol set in a search session	Instructions - SetDataSearch
Get next matching symbol	Functions - GetNextSym
Set the value of a data object	Instructions - SetDataVal
Set the value of many data objects	Instructions - SetAllDataVal
The related data type datapos	Data Types - datapos

GetSysData - Get system data

GetSysData fetches the value and optional symbol name for the current system data of specified data type.

With this instruction it is possible to fetch data for and the name of the current active Tool, Work Object or PayLoad (for robot).

Example

```
PERS tooldata curtoolvalue := [TRUE, [[0, 0, 0], [1, 0, 0, 0]],
                                [0, [0, 0, 0], [1, 0, 0, 0], 0, 0, 0]];
VAR string curtoolname;

GetSysData curtoolvalue;
```

Copy current active tool data value to the persistent variable *curtoolvalue*.

```
GetSysData curtoolvalue \ObjectName := curtoolname;
```

Copy also current active tool name to the variable *curtoolname*.

Arguments

GetSysData DestObject [\ ObjectName]

DestObject Data type: *anytype*

Persistent for storage of current active system data value.

The data type of this argument also specifies the type of system data (Tool, Work Object or PayLoad) to fetch.

[\ObjectName] Data type: *string*

Option argument (variable or persistent) to also fetch the current active system data name.

Program execution

When running the instruction *GetSysData* the current data value is stored in the specified persistent in argument *DestObject*.

If argument *\ObjectName* is used, the name of the current data is stored in the specified variable or persistent in argument *ObjectName*.

Current system data for Tool or Work Object is activated by execution of any move instruction or can be manually set in the jogging window.

Syntax

GetSysData
[DestObject':='] < persistent(**PERS**) of *anytype*>
['\'ObjectName':=' < expression (**INOUT**) of *string*>] ';'

Related information

	Described in:
Definition of tools	Data Types - tooldata
Definition of work objects	Data Types - wobjdata
Set system data	Instructions - SetSysData

GetTrapData - Get interrupt data for current TRAP

GetTrapData is used in a trap routine to obtain all information about the interrupt that caused the trap routine to be executed.

To be used in trap routines generated by instruction *IError*, before use of the instruction *ReadErrData*.

Example

```
VAR trapdata err_data;

GetTrapData err_data;
```

Store interrupt information in the non-value variable *err_data*.

Arguments

GetTrapData TrapEvent

TrapEvent Data type: *trapdata*

Variable for storage of the information about what caused the trap to be executed.

Limitation

This instruction can only be used in a TRAP routine.

Example

```
VAR errdomain err_domain;
VAR num err_number;
VAR errtype err_type;
VAR trapdata err_data;
.
TRAP trap_err
   GetTrapData err_data;
   ReadErrData err_data, err_domain, err_number, err_type;
ENDTRAP
```

When an error is trapped to the trap routine *trap_err*, the error domain, the error number, and the error type are saved into appropriate non-value variables of the type *trapdata*.

Syntax

GetTrapData
[TrapEvent ':='] <variable (**VAR**) of *trapdata*>';'

Related information

	Described in:
Summary of interrupts	RAPID Summary - Interrupts
More information on interrupt management	Basic Characteristics- Interrupts
Interrupt data for current TRAP	Data Types - trapdata
Orders an interrupt on errors	Instructions - IError
Get interrupt data for current TRAP	Instructions- GetTrapData
Gets information about an error	Instructions - ReadErrData

GOTO - Goes to a new instruction

GOTO is used to transfer program execution to another line (a label) within the same routine.

Examples

```
GOTO next;
   .
next:
```

Program execution continues with the instruction following next.

```
reg1 := 1;
next:
   .
reg1 := reg1 + 1;
IF reg1<=5 GOTO next;
```

The *next* program loop is executed five times.

```
IF reg1>100 GOTO highvalue;
lowvalue:
   .
GOTO ready;
highvalue:
   .
ready:
```

If *reg1 is greater than 100*, the *highvalue* program loop is executed; otherwise the *lowvalue* loop is executed.

Arguments

GOTO Label

Label Identifier

The label from where program execution is to continue.

Limitations

It is only possible to transfer program execution to a label within the same routine.

It is only possible to transfer program execution to a label within an IF or TEST instruction if the GOTO instruction is also located within the same branch of that instruction.

It is only possible to transfer program execution to a label within a FOR or WHILE instruction if the GOTO instruction is also located within that instruction.

Syntax

(EBNF)
GOTO <identifier>';'

Related information

	Described in:
Label	Instructions - label
Other instructions that change the program	RAPID Summary - flow Controlling the Program Flow

GripLoad - Defines the payload of the robot

GripLoad is used to define the payload which the robot holds in its gripper.

This instruction can only be used in the *Main* task or, if in a MultiMove System, in Motion tasks.

Description

It is important to always define the actual tool load and when used, the payload of the robot too. Incorrect definitions of load data can result in overloading of the robot mechanical structure.

When incorrect load data is specified, it can often lead to the following consequences:

- If the value in the specified load data is greater than that of the value of the true load;
  -> The robot will not be used to its maximum capacity
  -> Impaired path accuracy including a risk of overshooting

If the value in the specified load data is less than the value of the true load;
-> Impaired path accuracy including a risk of overshooting
-> Risk of overloading the mechanical structure

Examples

GripLoad piece1;

The robot gripper holds a load called *piece1*.

GripLoad load0;

The robot gripper releases all loads.

Arguments

GripLoad Load

Load Data type: *loaddata*

The load data that describes the current payload.

Program execution

The specified load affects the performance of the robot.

The default load, 0 kg, is automatically set

- at a cold start-up
- when a new program is loaded
- when starting program executing from the beginning.

Syntax

GripLoad
[Load ':='] < persistent (**PERS**) of *loaddata* > ';'

Related information

	Described in:
Definition of load data	Data Types - loaddata
Definition of tool load	Data Types - tooldata

HollowWristReset - Reset hollow wrist for IRB5402 and IRB5403

HollowWristReset resets the position of the wrist joints on hollow wrist manipulators, such as IRB5402 and IRB5403.

The instruction makes it possible to avoid rewinding the wrist joints 4 and 5 after they have been wound up one or more revolutions. After executing a *HollowWristReset* instruction, the wrist joints may continue to wind up in the same direction.

Description

HollowWristReset makes it easier to make application programs. You do not have to ensure that the wrist position is within +/-2 revolutions at the time of programming, and it may save cycle time because the robot does not have to spend time rewinding the wrist. However, there is a limitation of +/-144 revolutions for winding up joints 4 and 5 before the wrist position must be reset by *HollowWristReset*. The robot programmer must be aware of this limitation and take it into consideration when planning the robot programs. To ensure that the 144 revolution limit is not exceeded after running a “wrist-winding” program several times, you should always let the robot come to a complete stop and reset the absolute position in every program (or cycle/routine/module etc. as necessary). Please note that all axes must remain stopped during the execution of the *HollowWristReset* instruction. As long as these limitations are taken into consideration, joints 4 and 5 can wind indefinitely and independently of joint 6 during program execution.

Please use *HollowWristReset* instead of *IndReset* to reset the hollow wrist as this instruction preserves the joint limits for joint 6 in order to prevent too much twisting of the paint tubes/cables.

Example

```
MoveL p10,v800,fine,paintgun1\WObj:=workobject1;
HollowWristReset;
```

All active axes are stopped by a stop point and the wrist is reset.

Limitations

All active axes must be stopped while the *HollowWristReset* instruction is executed.

The wrist joints must be reset before any of them reach the +/-144 revolution limit (i.e. 51840 degrees/ 904 rad).

Whenever a program stop, emergency stop, power failure stop etc. occurs, the controller retains the path context in order to be able to return to the path and let the robot continue program execution from the point on the path at which it was stopped. In manual mode, if the manipulator has been moved out of the path between a stop and a restart, the operator is informed by the following message on the FlexPendant: **“Not on path! Robot has been moved after program stop. Should the robot return to the path on Start? Yes/No/Cancel”**. This provides an opportunity of returning to the path before restart. In automatic mode, the robot automatically returns to the path.

HollowWristReset removes the path context. This means that it is not possible to return to the path in case of a program restart, if the *HollowWristReset* instruction has been executed in the meantime. If this instruction is executed manually (“Special + Call Service Routine ...” in the programming window), it should only be executed at a time when returning to the path is not required. That is, after a program is completely finished, or an instruction is completely finished in step-by-step execution and the manipulator is not moved out of the path by jogging etc.

Syntax

HollowWristReset ‘;’

Related information

	Described in:
Related system parameters	System Parameters - Manipulator
Return to path	Motion and I/O Principles - Positioning during Program Execution

IDelete - Cancels an interrupt

IDelete (Interrupt Delete) is used to cancel (delete) an interrupt.

If the interrupt is to be only temporarily disabled, the instruction *ISleep* or *IDisable* should be used.

Example

IDelete feeder_low;

The interrupt *feeder_low* is cancelled.

Arguments

IDelete Interrupt

Interrupt Data type: *intnum*

The interrupt identity.

Program execution

The definition of the interrupt is completely erased. To define it again, it must first be re-connected to the trap routine.

The instruction should be preceded by a stop point. Otherwise the interrupt will be deactivated before the end point is reached.

Interrupts do not have to be erased; this is done automatically when

- a new program is loaded
- the program is restarted from the beginning
- the program pointer is moved to the start of a routine

Syntax

IDelete
[Interrupt ':='] < variable (**VAR**) of *intnum* > ';'

Related information

	Described in:
Summary of interrupts	RAPID Summary - Interrupts
Temporarily disabling an interrupt	Instructions - ISleep
Temporarily disabling all interrupts	Instructions - IDisable

IDisable - Disables interrupts

IDisable (Interrupt Disable) is used to disable all interrupts temporarily. It may, for example, be used in a particularly sensitive part of the program where no interrupts may be permitted to take place in case they disturb normal program execution.

Example

```
IDisable;
FOR i FROM 1 TO 100 DO
   character[i]:=ReadBin(sensor);
ENDFOR
IEnable;
```

No interrupts are permitted as long as the serial channel is reading.

Program execution

Interrupts, that occur during the time in which an *IDisable* instruction is in effect, are placed in a queue. When interrupts are permitted once more, the interrupt(s) of the program then immediately starts generating, executed in “first in - first out” order in the queue.

IEnable is active by default. *IEnable* is automatically set

- at a cold start-up
- when starting program execution from the beginning of *main*
- after executing one cycle (passing *main*) or executing *ExitCycle*

Syntax

IDisable‘;’

Related information

	Described in:
Summary of interrupts	RAPID Summary - Interrupt
Permitting interrupts	Instructions - IEnable

IEnable - Enables interrupts

IEnable (Interrupt Enable) is used to enable interrupts during program execution.

Example

```
IDisable;
FOR i FROM 1 TO 100 DO
   character[i]:=ReadBin(sensor);
ENDFOR
IEnable;
```

No interrupts are permitted as long as the serial channel is reading. When it has finished reading, interrupts are once more permitted.

Program execution

Interrupts which occur during the time in which an *IDisable* instruction is in effect, are placed in a queue. When interrupts are permitted once more (*IEnable*), the interrupt(s) of the program then immediately start generating, executed in “first in - first out” order in the queue. Program execution then continues in the ordinary program and interrupts which occur after this are dealt with as soon as they occur.

Interrupts are always permitted when a program is started from the beginning,. Interrupts disabled by the *ISleep* instruction are not affected by the *IEnable* instruction.

Syntax

IEnable‘;’

Related information

	Described in:
Summary of interrupts	RAPID Summary - Interrupts
Permitting no interrupts	Instructions - IDisable

IError - Orders an interrupt on errors

IError (*Interrupt Errors*) is used to order and enable an interrupt when an error occurs.

Error, warning, or state change can be logged with *IError*.
Refer to the *User Guide - Error Management, System and Error Messages* for more information.

Example

```
VAR intnum err_int;
...
CONNECT err_int WITH err_trap;
IError COMMON_ERR, TYPE_ALL, err_int;
```

Orders an interrupt in RAPID and execution of the TRAP routine *err_trap* each time an error, warning, or state change is generated in the system.

Arguments

IError ErrorDomain [\ErrorId] ErrorType Interrupt

ErrorDomain Data type: *errdomain*

The error domain that is to be monitored.
Refer to predefined data of type *errdomain*.
To specify any domain, use COMMON_ERR.

[\ErrorId] Data type: *num*

Optionally, the number of a specific error that is to be monitored.
The error number must be specified without the first digit (error domain) of the complete error number.
E.g. 10008 Program restarted, must be specified as 0008 or only 8.

ErrorType Data type: *errtype*

The type of event, such as error, warning, or state change, that is to be monitored.
Refer to predefined data of type *errtype*.
To specify any type, use TYPE_ALL.

Interrupt Data type: *intnum*

The interrupt identity. This should have been previously connected to a trap routine by means of the instruction CONNECT.

Program execution

The corresponding trap routine is automatically called when an error occurs, in the specified domain, of the specified type and optionally with the specified error number. When this has been executed, program execution continues from where the interrupt occurred

Example

```
VAR intnum err_interrupt;
VAR trapdata err_data;
VAR errdomain err_domain;
VAR num err_number;
VAR errtype err_type;
...
CONNECT err_interrupt WITH trap_err;
IError COMMON_ERR, TYPE_ERR, err_interupt;
...
IDelete err_interrupt;
...
TRAP trap_err
   GetTrapData err_data;
   ReadErrData err_data, err_domain, err_number, err_type;
   ! Set domain no 1 ... 13
   SetGO go_err1, err_domain;
   ! Set error no 1 ...9999
   SetGO go_err2, err_number;
ENDTRAP
```

When an error occurs (only error, not warning, or state change), the error number is retrieved in the trap routine and its value is used to set 2 groups of digital outputs.

Limitation

It is not possible to order an interrupt on internal errors.

In a task of type NORMAL the event will be thrown away at program stop.

The same variable for interrupt identity cannot be used more than once, without first deleting it. Interrupts should therefore be handled as shown in one of the alternatives below.

```
VAR intnum err_interrupt;

PROC main ( )
   CONNECT err_interrupt WITH err_trap;
   IError COMMON_ERR, TYPE_ERR, err_interupt;
   WHILE TRUE DO
   :
   :
   ENDWHILE
ENDPROC
```

Interrupts are activated at the beginning of the program. These instructions are then kept outside the main flow of the program.

```
PROC main ( )
   VAR intnum err_interrupt;
   CONNECT err_interrupt WITH err_trap;
   IError COMMON_ERR, TYPE_ERR, err_interupt;
   :
   :
   IDelete err_interrupt;
ENDPROC
```

The interrupt is deleted at the end of the program and is then reactivated. It should be noted, in this case, that the interrupt is inactive for a short period.

Syntax

IError
[ErrorDomain ':='] <expression (**IN**) of *errdomain*>
['\'ErrorId':=' <expression (**IN**) of *num*>']' ','
[ErrorType ':='] <expression (**IN**) of *errtype*> ','
[Interrupt ':='] <variable (**VAR**) of *intnum*>';'

Related information

	Described in:
Summary of interrupts	RAPID Summary - Interrupts
More information on interrupt management	Basic Characteristics- Interrupts
Error domains, predefined constants	Data Types - errdomain
Error types, predefined constants	Data Types - errtype
Get interrupt data for current TRAP	Instructions - GetTrapData
Gets information about an error	Instructions - ReadErrData

IF - If a condition is met, then ...; otherwise ...

IF is used when different instructions are to be executed depending on whether a condition is met or not.

Examples

```
IF reg1 > 5 THEN
   Set do1;
   Set do2;
ENDIF
```

The *do1 and do2* signals are set only if *reg1 is greater than 5*.

```
IF reg1 > 5 THEN
   Set do1;
   Set do2;
ELSE
   Reset do1;
   Reset do2;
ENDIF
```

The *do1 and do2* signals are set or reset depending on whether *reg1 is greater than 5* or not.

Arguments

IF Condition THEN ...
{ELSEIF Condition THEN ...}
[ELSE ...]
ENDIF

Condition Data type: *bool*

The condition that must be satisfied for the instructions between THEN and ELSE/ELSEIF to be executed.

Example

```
IF counter > 100 THEN
   counter := 100;
ELSEIF counter < 0 THEN
   counter := 0;
ELSE
   counter := counter + 1;
ENDIF
```

Counter is incremented by 1. However, if the value of *counter* is outside the limit *0-100, counter* is assigned the corresponding limit value.

Program execution

The conditions are tested in sequential order, until one of them is satisfied. Program execution continues with the instructions associated with that condition. If none of the conditions are satisfied, program execution continues with the instructions following ELSE. If more than one condition is met, only the instructions associated with the first of those conditions are executed.

Syntax

(EBNF)
IF <conditional expression> **THEN**
   <instruction list>
{**ELSEIF** <conditional expression> **THEN** <instruction list> | **<EIF>**}
[**ELSE**
   <instruction list>]
ENDIF

Related information

	Described in:
Conditions (logical expressions)	Basic Characteristics - Expressions

Incr - Increments by 1

Incr is used to add 1 to a numeric variable or persistent.

Example

Incr reg1;

1 is added to *reg1*, i.e. reg1:=reg1+1.

Arguments

Incr Name

Name Data type: *num*

The name of the variable or persistent to be changed.

Example

```
WHILE stop_production=0 DO
   produce_part;
   Incr no_of_parts;
   TPWrite "No of produced parts= "\Num:=no_of_parts;
ENDWHILE
```

The number of parts produced is updated on the FlexPendant each cycle. Production continues to run as long as the signal *stop_production* is not set.

Syntax

Incr
[Name ':='] < var or pers (**INOUT**) of *num* > ';'

Related information

	Described in:
Decrementing a variable by 1	Instructions - Decr
Adding any value to a variable	Instructions - Add
Changing data using an arbitrary	Instructions - := expression, e.g. multiplication

IndAMove - Independent absolute position movement

IndAMove is used to change an axis to independent mode and move the axis to a specific position.

An independent axis is an axis moving independently of other axes in the robot system. As program execution continues immediately, it is possible to execute other instructions (including positioning instructions) during the time the independent axis is moving.

If the axis is to be moved within a revolution, the instruction *IndRMove* should be used instead. If the move is to occur a short distance from the current position, the instruction *IndDMove* must be used.

This instruction can only be used in the *Main* task or, if in a MultiMove System, in Motion tasks.

Example

IndAMove Station_A,2\ToAbsPos:=p4,20;

Axis *2* of *Station_A* is moved to the position p4 at the speed *20* degrees/s.

Arguments

IndAMove MecUnit Axis [\ToAbsPos] | [\ToAbsNum] Speed [\Ramp]

MecUnit *(Mechanical Unit)* Data type: *mecunit*

The name of the mechanical unit.

Axis Data type: *num*

The number of the current axis for the mechanical unit (1-6).

[\ToAbsPos] *(To Absolute Position)* Data type: *robtarget*

Axis position specified as a *robtarget*. Only the component for this specific axis is used. The value is used as an absolute position value in degrees (mm for linear axes).

The axis position will be affected if the axis is displaced using the instruction *EOffsSet* or *EOffsOn*.

For robot axes, the argument *\ToAbsNum* is to be used instead.

[\ToAbsNum] *(To Absolute Numeric value)* Data type: *num*

Axis position defined in degrees (mm for linear axis).

Using this argument, the position will NOT be affected by any displacement, e.g. *EOffsSet* or *PDispOn*.

Same function as *\ToAbsPos* but the position is defined as a numeric value to make it easy to manually change the position.

Speed Data type: *num*

Axis speed in degrees/s (mm/s for linear axis).

[\Ramp] Data type: *num*

Decrease acceleration and deceleration from maximum performance (1 - 100%, 100% = maximum performance).

Program execution

When *IndAMove* is executed, the specified axis starts to move at the programmed speed to the specified axis position. If *\Ramp* is programmed, there will be a reduction of acceleration/deceleration.

To change the axis back to normal mode, the *IndReset* instruction is used. In connection with this, the logical position of the axis can be changed, so that a number of revolutions are erased from the position, for example, to avoid rotating back for the next movement.

The speed can be altered by executing another *IndAMove* instruction (or another *Ind_Move* instruction). If a speed in the opposite direction is selected, the axis stops and then accelerates to the new speed and direction.

For stepwise execution of the instruction, the axis is set in independent mode only. The axis begins its movement when the next instruction is executed, and continues as long as program execution takes place. For more information see Chapter 6, Motion and I/O principles.

When the program pointer is moved to the start of the program, or to a new routine, all axes are automatically set to normal, without changing the measurement system (equivalent to executing the instruction *IndReset\Old*).

Note that an *IndAMove* instruction after an *IndCMove* operation can result in the axis spinning back the movement performed in the *IndCMove* instruction. To prevent this, use an *IndReset* instruction before the *IndAMove*, or use an *IndRMove* instruction.

Limitations

Axes in independent mode cannot be jogged. If an attempt is made to execute the axis manually, the axis will not move, and an error message will be displayed. Execute an *IndReset* instruction or move the program pointer to main, in order to leave independent mode.

If a loss of voltage occurs when an axis is in independent mode, the program cannot be restarted. An error message is displayed and the program must be started from the beginning.

The instruction is not advisable for coupled robot wrist axes (see Rapid Reference Manual - Motion and I/O Principles - Positioning during Program Excution - Independent Axes).

Example

```
ActUnit Station_A;
weld_stationA;
IndAMove Station_A,1\ToAbsNum:=90,20\Ramp:=50;
ActUnit Station_B;
weld_stationB_1;
WaitUntil IndInpos(Station_A,1 ) = TRUE;
WaitTime 0.2;
DeactUnit Station_A;
weld_stationB_2;
```

Station_A is activated and the welding is started in station A.

Station_A (axis 1) is then moved to the 90 degrees position while the robot is welding in station B. The speed of the axis is 20 degrees/s . The speed is changed with acceleration/deceleration reduced to 50% of max performance.

When station A reaches this position, it is deactivated and reloading can take place in the station at the same time as the robot continues to weld in station B.

Error handling

If the axis is not activated, the system variable ERRNO is set to ERR_AXIS_ACT. This error can then be handled in the error handler.

Syntax

IndAMove
[MecUnit':='] < variable (**VAR**) of *mecunit*> ','
[Axis':='] < expression (**IN**) of *num*>
['\'ToAbsPos':=' < expression (**IN**) of *robtarget*>]
| ['\' ToAbsNum':=' < expression (**IN**) of *num*>] ','
[Speed ':='] < expression (**IN**) of *num*>
['\' Ramp':=' < expression (**IN**) of *num* >] ';'

Related information

	Described in:
Independent axes in general	Motion and I/O Principles -Program execution
Change back to normal mode	Instructions - IndReset
Reset the measurement system	Instructions - IndReset
Move an independent axis to a specific	Instructions - IndRMove position within current revolution
Move an independent axis a specific	Instructions - IndDMove distance
Check the speed status for independent axes	Functions - IndSpeed
Check the position status for independent axes	Functions - IndInpos
Defining independent joints	System Parameters - Manipulator

IndCMove - Independent continuous movement

IndCMove is used to change an axis to independent mode and start the axis moving continuously at a specific speed.

An independent axis is an axis moving independently of other axes in the robot system. As program execution continues immediately, it is possible to execute other instructions (including positioning instructions) during the time the independent axis is moving.

This instruction can only be used in the *Main* task or, if in a MultiMove System, in Motion tasks.

Example

IndCMove Station_A,2,-30.5;

Axis *2* of *Station_A* starts to move in a negative direction at a speed of *30.5* degrees/s.

Arguments

IndCMove **MecUnit Axis Speed [\Ramp]**

MecUnit *(Mechanical Unit)* Data type: *mecunit*

The name of the mechanical unit.

Axis Data type: *num*

The number of the current axis for the mechanical unit (1-6).

Speed Data type: *num*

Axis speed in degrees/s (mm/s for linear axis).
The direction of movement is specified as the sign of the speed argument.

[\Ramp] Data type: *num*

Decrease acceleration and deceleration from maximum performance (1 - 100%, 100% = maximum performance).

Program execution

When *IndCMove* is executed, the specified axis starts to move at the programmed speed. The direction of movement is specified as the sign of the speed argument. If *\Ramp* is programmed there will be a reduction of acceleration/deceleration.

To change the axis back to normal mode, the *IndReset* instruction is used. The logical position of the axis can be changed in connection with this - an number of full revolutions can be erased, for example, to avoid rotating back for the next movement.

The speed can be changed by executing a further *IndCMove* instruction. If a speed in the opposite direction is ordered, the axis stops and then accelerates to the new speed and direction. To stop the axis, speed argument 0 can be used. It will then still be in independent mode.

During stepwise execution of the instruction, the axis is set in independent mode only. The axis starts its movement when the next instruction is executed, and continues as long as program execution continues. For more information see Chapter 6, Motion and I/O principles.

When the program pointer is moved to the beginning of the program, or to a new routine, all axes are set automatically to normal mode, without changing the measurement system (equivalent to executing the instruction *IndReset\Old*).

Limitations

The resolution of the axis position worsens, the further it is moved from its logical zero position (usually the middle of the working area). To achieve high resolution again, the logical working area can be set to zero with the instruction *IndReset*. For more information see Chapter 6, Motion and I/O Principles.

Axes in independent mode cannot be jogged. If an attempt is made to execute the axis manually, the axis will not move, and an error message will be displayed. Execute an *IndReset* instruction or move the program pointer to main, in order to leave independent mode.

If a loss of voltage occurs when the axis is in independent mode, the program cannot be restarted. An error message is displayed, and the program must be started from the beginning.

The instruction is not advisable for coupled robot wrist axes (see Rapid Reference Manual - Motion and I/O Principles - Positioning during Program Excution - Independent Axes).

Example

```
IndCMove Station_A,2,20;
WaitUntil IndSpeed(Station_A,2 \InSpeed) = TRUE;
WaitTime 0.2;
MoveL p10, v1000, fine, tool1;
IndCMove Station_A,2,-10\Ramp:=50;
MoveL p20, v1000, z50, tool1;
IndRMove Station_A,2 \ToRelPos:=p1 \Short,10;
MoveL p30, v1000, fine, tool1;
WaitUntil IndInpos(Station_A,2 ) = TRUE;
WaitTime 0.2;
IndReset Station_A,2 \RefPos:=p40\Short;
MoveL p40, v1000, fine, tool1;
```

Axis *2* of *Station_A* starts to move in a positive direction at a speed of 20 degrees/s. When this axis has reached the selected speed the robot axes start to move.

When the robot reaches position *p10*, the external axis changes direction and rotates at a speed of 10 degrees/s . The change of speed is performed with acceleration/deceleration reduced to 50% of maximum performance. At the same time, the robot executes towards *p20*.

Axis *2* of *Station_A* is then stopped as quickly as possible in position *p1* within the current revolution.

When axis 2 has reached this position, and the robot has stopped in position p30, axis 2 returns to normal mode again. The measurement system offset for this axis is changed a whole number of axis revolutions so that the actual position is as close as possible to *p40*.

When the robot is then moved to position *p40*, axis *2* of *Station_A* will be moved via the shortest route to position *p40* (max ±180 degrees).

Error handling

If the axis is not activated, the system variable ERRNO is set to ERR_AXIS_ACT. This error can then be handled in the error handler.

Syntax

IndCMove
[MecUnit':='] < variable (**VAR**) of *mecunit*> ','
[Axis':='] < expression (**IN**) of *num*> ','
[Speed ':='] < expression (**IN**) of *num*>
['\' Ramp':=' < expression (**IN**) of *num* >] ';'

Related information

	Described in:
Independent axes in general	Motion and I/O Principles - Program execution
Change back to normal mode	Instructions - IndReset
Reset the measurement system	Instructions - IndReset
Move an independent axis to a specific	Instructions - IndAMove, IndRMove position
Move an independent axis a specific	Instructions - IndDMove distance
Check the speed status for independent axes	Functions - IndSpeed
Check the position status for independent axes	Functions - IndInpos
Defining independent joints	System Parameters -Manipulator

IndDMove - Independent delta position movement

IndDMove is used to change an axis to independent mode and move the axis a specific distance.

An independent axis is an axis moving independently of other axes in the robot system. As program execution continues immediately, it is possible to execute other instructions (including positioning instructions) during the time the independent axis is moving.

If the axis is to be moved to a specific position, the instruction *IndAMove* or *IndRMove* must be used instead.

This instruction can only be used in the *Main* task or, if in a MultiMove System, in Motion tasks.

Example

IndDMove Station_A,2,-30,20;

Axis *2* of *Station_A* is moved 30 degrees in a negative direction at a speed of *20* degrees/s.

Arguments

IndDMove **MecUnit Axis Delta Speed [\Ramp]**

MecUnit *(Mechanical Unit)* Data type: *mecunit*

The name of the mechanical unit.

Axis Data type: *num*

The number of the current axis for the mechanical unit (1-6).

Delta Data type: *num*

The distance which the current axis is to be moved, expressed in degrees (mm for linear axes). The sign specifies the direction of movement.

Speed Data type: *num*

Axis speed in degrees/s (mm/s for linear axis).

[\Ramp] Data type: *num*

Decrease acceleration and deceleration from maximum performance (1 - 100%, 100% = maximum performance).

Program execution

When *IndAMove* is executed, the specified axis starts to move at the programmed speed for the specified distance. The direction of movement is specified as the sign of the *Delta* argument. If *\Ramp* is programmed there will be a reduction of acceleration/ deceleration.

If the axis is moving, the new position is calculated from the momentary position of the axis, when the instruction *IndDMove* is executed. If an *IndDMove* instruction with distance 0 is executed, the axis will stop and then move back to the position which the axis had when the instruction was executed.

To change the axis back to normal mode, the *IndReset* instruction is used. The logical position of the axis can be changed in connection with this - a number of full revolutions can be erased from the position, for example, to avoid rotating back for the next movement.

The speed can be changed by running a further *IndDMove* instruction (or another *Ind_Move* instruction). If a speed in the opposite direction is selected, the axis stops and then accelerates to the new speed and direction.

During stepwise execution of the instruction, the axis is set in independent mode only. The axis starts its movement when the next instruction is executed, and continues as long as program execution continues. For more information see Chapter 6, Motion and I/O principles.

When the program pointer is moved to the beginning of the program, or to a new routine, all axes are automatically set to normal mode, without changing the measurement system (equivalent to running the instruction *IndReset \Old*).

Limitations

Axes in independent mode cannot be jogged. If an attempt is made to execute the axis manually, the axis will not move, and an error message will be displayed. Execute an *IndReset* instruction or move the program pointer to main, in order to leave independent mode.

If a loss of voltage occurs when the axis is in independent mode, the program cannot be restarted. An error message is displayed, and the program must be started from the beginning.

The instruction is not advisable for coupled robot wrist axes (see Rapid Reference Manual - Motion and I/O Principles - Positioning during Program Excution - Independent Axes).

Example

```
IndAMove Robot,6\ToAbsNum:=90,20;
WaitUntil IndInpos(Station_A,1 ) = TRUE;
WaitTime 0.2;
IndDMove Station_A,2,-30,20;
WaitUntil IndInpos(Station_A,1 ) = TRUE;
WaitTime 0.2;
IndDMove Station_A,2,400,20;
```

Axis 6 of the robot is moved to the following positions:

- 90 degrees
- 60 degrees
- 460 degrees (1 revolution + 100 degrees).

Error handling

If the axis is not activated, the system variable ERRNO is set to ERR_AXIS_ACT. This error can then be handled in the error handler.

Syntax

IndDMove
[MecUnit':='] < variable (**VAR**) of *mecunit*> ','
[Axis':='] < expression (**IN**) of *num*> ','
[Delta':='] < expression (**IN**) of *num*>','
[Speed ':='] < expression (**IN**) of *num*>
['\' Ramp':=' < expression (**IN**) of *num* >] ';'

Related information

	Described in:
Independent axes in general	Motion and I/O Principles - Program execution
Change back to normal mode	Instructions - IndReset
Reset the measurement system	Instructions - IndReset
Move an independent axis to a specific	Instructions - IndAMove, IndRMove position
Check the speed status for independent axes	Functions - IndSpeed
Check the position status for independent axes	Functions - IndInpos
Defining independent joints	System Parameters -Manipulator

IndReset - Independent reset

IndReset is used to change an independent axis back to normal mode. At the same time, the measurement system for rotational axes can be moved a number of axis revolutions.

This instruction can only be used in the Main task or, if in a MultiMove System, in Motion tasks.

Example

```
IndCMove Station_A,2,5;
MoveL *,v1000,fine,tool1;
IndCMove Station_A,2,0;
WaitUntil IndSpeed(Station_A,2\ZeroSpeed);
WaitTime 0.2
IndReset Station_A,2;
```

Axis *2* of *Station _A* is first moved in independent mode and then changed back to normal mode. The axis will keep its position.

Note that the current independent axis, and the normal axes, should not move when the instruction *IndReset* is executed. This is because the previous position is a stop point, and an *IndCMove* instruction is executed at zero speed. Furthermore, a pause of 0.2 seconds is used to ensure that the correct status has been achieved.

Arguments

IndReset **MecUnit Axis [\RefPos] | [\RefNum] [\Short] | [\Fwd] | [\Bwd] | \Old]**

MecUnit *(Mechanical Unit)* Data type: *mecunit*

The name of the mechanical unit.

Axis Data type: *num*

The number of the current axis for the mechanical unit (1-6).

[\RefPos] *(Reference Position)* Data type: *robtarget*

Axis position specified as a *robtarget*. Only the component for this specific axis is used. The position must be inside the normal working range.

For robot axes, the argument *\RefNum* is to be used instead.

The argument is only to be defined together with the argument *\Short, \Fwd* or *\Bwd*. It is not allowed together with the argument *\Old*.

[\RefNum] *(Reference Numeric value)* Data type: *num*

Axis position defined in degrees (mm for linear axis). The position must be inside the normal working range.

The argument is only to be defined together with the argument *\Short, \Fwd* or *\Bwd*. It is not allowed together with the argument *\Old*.

Same function as *\RefPos* but the position is defined as a numeric value to make it easy to change the position manually.

[\Short] Data type: *switch*

The measurement system will change a whole number of revolutions on the axis side so that the axis will be as close as possible to the specified *\RefPos* or *\RefNum* position. If a positioning instruction with the same position is executed after *IndReset*, the axis will travel the shortest route, less than ±180 degrees, in order to reach the position.

[\Fwd] *(Forward)* Data type: *switch*

The measurement system will change a whole number of revolutions on the axis side so that the reference position will be on the positive side of the specified *\RefPos* or *\RefNum* position. If a positioning instruction with the same position is executed after *IndReset*, the axis will turn in a positive direction less than 360 degrees in order to reach the position.

[\Bwd] *(Backward)* Data type: *switch*

The measurement system will change a whole number of revolutions on the axis side so that the reference position will be on the negative side of the specified *\RefPos* or *\RefNum* position. If a positioning instruction with the same position is executed after *IndReset*, the axis will turn in a negative direction less than 360 degrees in order to reach the position.

[\Old] Data type: *switch*

Keeps the old position. Note that resolution is decreased in positions far away from zero.

If no argument *\Short, \Fwd, \Bwd* or *\Old* is specified - *\Old* is used as default value.

Program execution

When *IndReset* is executed, it changes the independent axis back to normal mode. At the same time, the measurement system for the axis can be moved by a whole number of axis revolutions.

The instruction may also be used in normal mode in order to change the measurement system.

Note that the position is used only to adjust the measurement system - the axis will not move to the position.

Limitations

The instruction may only be executed when all active axes running in normal mode are standing still. The independent mode axis which is going to be changed to normal mode must also be stationary. For axes in normal mode this is achieved by executing a move instruction with the argument *fine*. The independent axis is stopped by an *IndCMove* with *Speed*:=0 (followed by a wait period of 0.2 seconds), *IndRMove*, *IndAMove* or *IndDMove* instruction.

The resolution of positions is decreased when moving away from logical position 0. An axis which progressively rotates further and further from the position 0 should thus be set to zero using the instruction *IndReset* with an argument other than *\Old*.

The measurement system cannot be changed for linear axes.

To ensure a proper start after *IndReset* of an axis with a relative measured measurement system (synchronization switches), an extra time delay of 0.12 seconds must be added after the *IndReset* instruction.

Only robot axis 6 can be used as independent axis. The IndReset instruction can also be used for axis 4 on models IRB2400 and IRB 4400. If *IndReset* is used on robot axis 4, then axis 6 must not be in the independent mode.

Example

```
IndAMove Station_A,1\ToAbsNum:=750,50;
WaitUntil IndInpos(Station_A,1);
WaitTime 0.2;
IndReset Station_A,1 \RefNum:=0 \Short;.
IndAMove Station_A,1\ToAbsNum:=750,50;
WaitUntil IndInpos(Station_A,1);
WaitTime 0.2;
IndReset Station_A,1 \RefNum:=300 \Short;
```

Axis 1 in *Station_A* is first moved independently to the 750 degrees position (2 revolutions and 30 degrees). At the same time as it changes to normal mode, the logical position is set to 30 degrees.

Axis 1 in *Station_A* is subsequently moved to the 750 degrees position (2 revolutions and 30 degrees). At the same time as it changes to normal mode, the logical position is set to 390 degrees (1 revolution and 30 degrees).

Error handling

If the axis is moving, the system variable ERRNO is set to ERR_AXIS_MOVING.

If the axis is not activated, the system variable ERRNO is set to ERR_AXIS_ACT. This error can then be handled in the error handler.

Syntax

IndReset
[MecUnit':='] < variable (**VAR**) of *mecunit*> ','
[Axis':='] < expression (**IN**) of *num*>
['\' RefPos':=' < expression (**IN**) of robtarget>]
| ['\' RefNum':=' < expression (**IN**) of num>]
['\' Short] | ['\' Fwd] | ['\' Bwd] | ['\' Old]';'

Related information

	Described in:
Independent axes in general	Motion and I/O Principles - Program execution
Change an axis to independent mode	Instructions - IndAMove, IndCMove, IndDMove, IndRMove
Check the speed status for independent axes	Functions - IndSpeed
Check the position status for independent axes	Functions - IndInpos
Defining independent joints	System Parameters -Manipulator

IndRMove - Independent relative position movement

IndRMove is used to change a rotational axis to independent mode and move the axis to a specific position within one revolution.

An independent axis is an axis moving independently of other axes in the robot system. As program execution continues immediately, it is possible to execute other instructions (including positioning instructions) during the time the independent axis is moving.

If the axis is to be moved to an absolute position (several revolutions) or if the axis is linear, the instruction *IndAMove* is used instead. If the movement is to take place a certain distance from the current position, the instruction *IndDMove* must be used.

This instruction can only be used in the *Main* task or, if in a MultiMove System, in Motion tasks.

Example

IndRMove Station_A,2\ToRelPos:=p5 \Short,20;

Axis *2* of *Station_A* is moved the shortest route to position *p5* within one revolution (maximum rotation ± 180 degrees) at a speed of *20* degrees/s.

Arguments

IndRMove MecUnit Axis [\ToRelPos] | [\ToRelNum] [\Short] | [\Fwd] | [\Bwd] Speed [\Ramp]

MecUnit *(Mechanical Unit)* Data type: *mecunit*

The name of the mechanical unit.

Axis Data type: *num*

The number of the current axis for the mechanical unit (1-6).

[\ToRelPos] *(To Relative Position)* Data type: *robtarget*

Axis position specified as a *robtarget*. Only the component for this specific axis is used. The value is used as a position value in degrees within one axis revolution. This means that the axis moves less than one revolution.

The axis position will be affected if the axis is displaced using the instruction *EOffsSet* or *EOffsOn*.

For robot axes, the argument *\ToRelNum* is to be used instead.

[\ToRelNum] *(To Relative Numeric value)* Data type: *num*

Axis position defined in degrees.

Using this argument, the position will NOT be affected by any displacement, e.g. *EOffsSet* or *PDispOn*.

Same function as *\ToRelPos* but the position is defined as a numeric value to make it easy to change the position manually.

[\Short] Data type: *switch*

The axis is moved the shortest route to the new position. This means that the maximum rotation will be 180 degrees in any direction. The direction of movement therefore depends on the current location of the axis.

[\Fwd] *(Forward)* Data type: *switch*

The axis is moved in a positive direction to the new position. This means that the maximum rotation will be 360 degrees and always in a positive direction (increased position value).

[\Bwd] *(Backward)* Data type: *switch*

The axis is moved in a negative direction to the new position. This means that the maximum rotation will be 360 degrees and always in a negative direction (decreased position value).

If *\Short, \Fwd* or *\Bwd* argument is omitted, *\Short* is used as default value.

Speed Data type: *num*

Axis speed in degrees/s.

[\Ramp] Data type: *num*

Decrease acceleration and deceleration from maximum performance (1 - 100%, 100% = maximum performance).

Program execution

When *IndRMove* is executed, the specified axis starts to move at the programmed speed to the specified axis position, but only a maximum of one revolution. If *\Ramp* is programmed, there will be a reduction of acceleration/deceleration.

To change the axis back to normal mode, the *IndReset* instruction is used. The logical position of the axis can be changed in connection with this - a number of full revolutions can be erased from the position, for example, to avoid rotating back for the next movement.

The speed can be changed by running a further *IndRMove* instruction (or another *Ind_Move* instruction). If a speed in the opposite direction is selected, the axis stops and then accelerates to the new speed and direction.

During stepwise execution of the instruction, the axis is set in independent mode only. The axis starts its movement when the next instruction is executed, and continues as long as program execution continues. For more information see Chapter 6, Motion and I/O principles.

When the program pointer is moved to the beginning of the program, or to a new routine, all axes are automatically set to normal mode, without changing the measurement system (equivalent to running the instruction *IndReset \Old*).

Limitations

Axes in independent mode cannot be jogged. If an attempt is made to execute the axis manually, the axis will not move, and an error message will be displayed. Execute an *IndReset* instruction or move the program pointer to main, in order to leave independent mode.

If a loss of voltage occurs when the axis is in independent mode, the program cannot be restarted. An error message is displayed, and the program must be started from the beginning.

The instruction is not advisable for coupled robot wrist axes (see Rapid Reference Manual - Motion and I/O Principles - Positioning during Program Excution - Independent Axes).

Examples

```
IndRMove Station_A,1\ToRelPos:=p5 \Fwd,20\Ramp:=50;
```

Axis *1* of *Station_A* starts to move in a positive direction to the position *p5* within one revolution (maximum rotation 360 degrees) at a speed of *20* degrees/s. The speed is changed with acceleration/deceleration reduced to 50% of maximum performance.

```
IndAMove Station_A,1\ToAbsNum:=90,20;
WaitUntil IndInpos(Station_A,1 ) = TRUE;
IndRMove Station_A,1\ToRelNum:=80 \Fwd,20;
WaitTime 0.2;
WaitUntil IndInpos(Station_A,1 ) = TRUE;
WaitTime 0.2;
IndRMove Station_A,1\ToRelNum:=50 \Bwd,20;
WaitUntil IndInpos(Station_A,1 ) = TRUE;
WaitTime 0.2;
IndRMove Station_A,1\ToRelNum:=150 \Short,20;
WaitUntil IndInpos(Station_A,1 ) = TRUE;
```

```
WaitTime 0.2;
IndAMove Station_A,1\ToAbsNum:=10,20;
```

Axis 1 of *Station_A* is moved to the following positions:

- 90 degrees
- 440 degrees (1 revolution + 80 degrees)
- 410 degrees (1 revolution + 50 degrees)
- 510 degrees (1 revolution + 150 degrees)
- 10 degrees

Error handling

If the axis is not activated, the system variable ERRNO is set to ERR_AXIS_ACT. This error can then be handled in the error handler.

Syntax

IndRMove
[MecUnit':='] < variable (**VAR**) of *mecunit*> ','
[Axis':='] < expression (**IN**) of *num*>
['\'ToRelPos':=' < expression (**IN**) of *robtargets*>]
| ['\'ToRelNum':=' < expression (**IN**) of *num*>]
['\'Short] | ['\' Fwd] | ['\' Bwd] ','
[Speed ':='] < expression (**IN**) of *num*>
['\'Ramp':=' < expression (**IN**) of *num* >] ';'

Related information

	Described in:
Independent axes in general	Motion and I/O Principles - Program execution
Change back to normal mode	Instructions - IndReset
Reset the measurement system	Instructions - IndReset
Move an independent axis to an absolute	Instructions - IndAMove position
Move an independent axis a specific	Instructions - IndDMove distance
More examples	Instructions - IndCMove
Check the speed status for independent axes	Functions - IndSpeed
Check the position status for independent axes	Functions - IndInpos
Defining independent joints	System Parameters -Manipulator

InvertDO - Inverts the value of a digital output signal

InvertDO (Invert Digital Output) inverts the value of a digital output signal (0 -> 1 and 1 -> 0).

Example

InvertDO do15;

The current value of the signal *do15* is inverted.

Arguments

InvertDO Signal

Signal Data type: *signaldo*

The name of the signal to be inverted.

Program execution

The current value of the signal is inverted (see Figure 8).

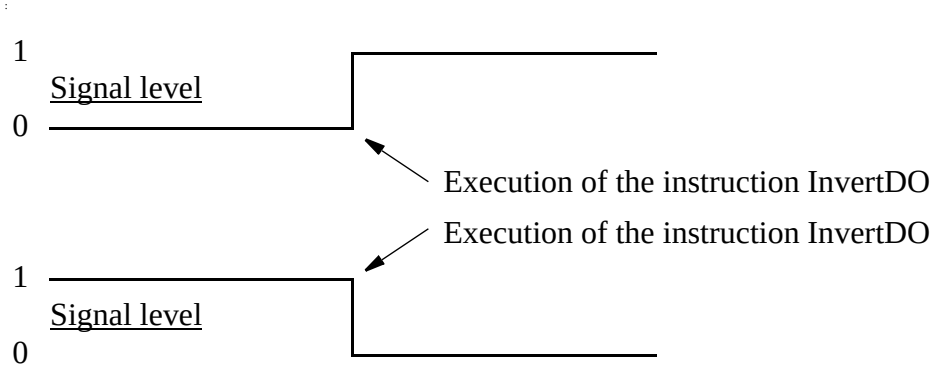


Figure 8 Inversion of a digital output signal.

Error handling

Following recoverable error can be generated. The error can be handled in an error handler. The system variable ERRNO will be set to:

ERR_NORUNUNIT	if there is no contact with the unit

Syntax

InvertDO
[Signal ':='] < variable (**VAR**) of *signaldo* > ';'

Related information

	Described in:
Input/Output instructions	RAPID Summary - Input and Output Signals
Input/Output functionality in general	Motion and I/O Principles - I/O Principles
Configuration of I/O	System Parameters

IODisable - Disable I/O unit

IODisable is used to disable an I/O unit during program execution.

I/O units are automatically enabled after start-up if they are defined in the system parameters. When required for some reason, I/O units can be disabled or enabled during program execution.

Examples

CONST string cell1:=”cell1”;

IODisable cell1, 5;

Disable I/O unit with name *cell1*.Wait max. *5* s.

Arguments

IODisable UnitName MaxTime

UnitName Data type: *string*

The name of the I/O unit to be disabled (with same name as configured).

MaxTime Data type: *num*

The maximum period of waiting time permitted, expressed in seconds. If this time runs out before the I/O unit has finished the disable steps, the error handler will be called, if there is one, with the error code ERR_IODISABLE. If there is no error handler, the execution will be stopped.

To disable an I/O unit takes about 0-5 s.

Program execution

The specified I/O unit starts the disable steps. The instruction is ready when the disable steps are finished. If the *MaxTime* runs out before the I/O unit has finished the disable steps, a recoverable error will be generated.

After disabling an I/O unit, any setting of outputs in this unit will result in an error.

Error handling

Following recoverable errors can be generated. The errors can be handled in an error handler. The system variable ERRNO will be set to:

ERR_IODISABLE	if the time out time runs out before the unit is disabled.
ERR_CALLIO_INTER	if an IOEnable or IODisable request is interrupted by another request to the same unit.
ERR_NAME_INVALID	if the unit name don't exist or if the unit isn't allowed to be disabled.

Example

```
PROC go_home()
        VAR num recover_flag :=0;
        ...
        ! Start to disable I/O unit cell1
        recover_flag := 1;
        IODisable "cell1", 0;
        ! Move to home position
        MoveJ home, v1000,fine,tool1;
        ! Wait until disable of I/O unit cell1 is ready
        recover_flag := 2;
        IODisable "cell1", 5;
        ...
        ERROR
                IF ERRNO = ERR_IODISABLE THEN
                        IF recover_flag = 1 THEN
                                TRYNEXT;
                        ELSEIF recover_flag = 2 THEN
                                RETRY;
                        ENDIF
                ELSEIF ERRNO = ERR_EXCRTYMAX THEN
                        ErrWrite "IODisable error", "Not pos-
sible to disable I/O unit cell1";
                        Stop;
                ENDIF
ENDPROC
```

To save cycle time, the I/O unit *cell1* is disabled during robot movement to the *home* position. With the robot at the *home* position, a test is done to establish whether or not the I/O unit *cell1* is fully disabled. After the max. number of retries (5 with a waiting time of 5 s), the robot execution will stop with an error message.

The same principle can be used with *IOEnable* (this will save more cycle time compared with *IODisable*).

Syntax

IODisable
[UnitName ':='] < expression (**IN**) of *string*> ','
[MaxTime ':='] < expression (**IN**) of *num* > ';'

Related information

	Described in:
Enabling an I/O unit	Instructions - IOEnable
Input/Output instructions	RAPID Summary - Input and Output Signals
Input/Output functionality in general	Motion and I/O Principles - I/O Principles
Configuration of I/O	System Parameters

IOEnable - Enable I/O unit

IOEnable is used to enable an I/O unit during program execution.

I/O units are automatically enabled after start-up if they are defined in the system parameters. When required for some reason, I/O units can be disabled or enabled during program execution.

Examples

CONST string cell1:=”cell1”;

IOEnable cell1, 5;

Enable I/O unit with name *cell1*. Wait max. *5* s.

Arguments

IOEnable UnitName MaxTime

UnitName Data type: *string*

The name of the I/O unit to be enabled (with same name as configured).

MaxTime Data type: *num*

The maximum period of waiting time permitted, expressed in seconds. If this time runs out before the I/O unit has finished the enable steps, the error handler will be called, if there is one, with the error code ERR_IOENABLE. If there is no error handler, the execution will be stopped.

To enable an I/O unit takes about 2-5 s.

Program execution

The specified I/O unit starts the enable steps. The instruction is ready when the enable steps are finished. If the *MaxTime* runs out before the I/O unit has finished the enable steps, a recoverable error will be generated.

After a sequence of *IODisable - IOEnable*, all outputs for the current I/O unit will be set to the old values (before *IODisable*).

Error handling

Following recoverable errors can be generated. The errors can be handled in an error handler. The system variable ERRNO will be set to:

ERR_IOENABLE	if the time out time runs out before the unit is enabled.
ERR_CALLIO_INTER	if an IOEnable or IODisable request is interrupted by another request to the same unit.
ERR_NAME_INVALID	if the unit name don't exist or if the unit isn't allowed to be disabled.

Example

IOEnable can also be used to check whether some I/O unit is disconnected for some reason.

```
VAR num max_retry:=0;
...
IOEnable "cell1", 0;
SetDO cell1_sig3, 1;
...
ERROR
        IF ERRNO = ERR_IOENABLE THEN
                IF max_retry < 5 THEN
                        WaitTime 1;
                        max_retry := max_retry + 1;
                        RETRY;
                ELSE
                        RAISE;
                ENDIF
        ENDIF
```

Before using signals on the I/O unit *cell1*, a test is done by trying to enable the I/O unit with timeout after *0* sec. If the test fails, a jump is made to the error handler. In the error handler, the program execution waits for *1* sec. and a new retry is made. After *5* retry attempts the error ERR_IOENABLE is propagated to the caller of this routine.

Syntax

```
IOEnable
   [ UnitName ':=' ] < expression (IN) of string> ','
   [ MaxTime ':=' ] < expression (IN) of num > ';'
```

Related information

	Described in:
More examples	Instructions - IODisable
Disabling an I/O unit	Instructions - IODisable
Input/Output instructions	RAPID Summary - Input and Output Signals
Input/Output functionality in general	Motion and I/O Principles - I/O Principles
Configuration of I/O	System Parameters

IPers - Interrupt at value change of a persistent variable

IPers (Interrupt Persistent) is used to order and enable interrupts to be generated when the value of a persistent variable is changed.

Example

```
VAR intnum pers1int;
PERS num counter := 0;

PROC main()
   CONNECT pers1int WITH iroutine1;
   IPers counter, pers1int;
   ...
   Idelete pers1int;
ENDPROC

TRAP iroutine1
   TPWrite “Current value of counter = “ \Num:=counter;
ENDTRAP
```

Orders an interrupt which is to occur each time the persistent variable *counter* is changed. A call is then made to the *iroutine1* trap routine.

Arguments

IPers **Name Interrupt**

Name Data type: *anytype*

The name of the persistent variable that is to generate interrupts.

Interrupt Data type: *intnum*

The interrupt identity. This should have previously been connected to a trap routine by means of the instruction *CONNECT.*

Program execution

When the persistent changes value, a call is made to the corresponding trap routine. When this routine has been executed, program execution continues from where the interrupt occurred.

If the persistent changes value during a program stop, no interrupt will occur when the program starts again.

Limitations

The same variable for interrupt identity cannot be used more than once, without first deleting it. See Instructions - *ISignalDI*.

If subscription on part of data such as record component or array element specified in parameter *Name*, the interrupt will occurs every time any part of the data is changed.

Syntax

IPers
[Name ':='] < persistent (**PERS**) of *anytype* > ','
[Interrupt ':='] < variable (**VAR**) of *intnum* > ';'

Related information

	Described in:
Summary of interrupts	RAPID Summary - Interrupts
Interrupt from an input signal	Instructions - ISignalDI
More information on interrupt management	Basic Characteristics- Interrupts
More examples	Data Types - intnum

ISignalAI - Interrupts from analog input signal

ISignalAI (Interrupt Signal Analog Input) is used to order and enable interrupts from an analog input signal.

Example

```
VAR intnum sig1int;
CONNECT sig1int WITH iroutine1;
ISignalAI \Single, ai1, AIO_BETWEEN, 1.5, 0.5, 0, sig1int;
```

Orders an interrupt which is to occur the first time the logical value of the analog input signal *ai1* is between *0.5* and *1.5*. A call is then made to the *iroutine1* trap routine.

```
ISignalAI ai1, AIO_BETWEEN, 1.5, 0.5, 0.1, sig1int;
```

Orders an interrupt which is to occur each time the logical value of the analog input signal *ai1* is between *0.5* and *1.5*, and the absolute signal difference compared to the stored reference value is bigger than *0.1*.

```
ISignalAI ai1, AIO_OUTSIDE, 1.5, 0.5, 0.1, sig1int;
```

Orders an interrupt which is to occur each time the logical value of the analog input signal *ai1* is lower than *0.5* or higher than *1.5*, and the absolute signal difference compared to the stored reference value is bigger than *0.1*.

Arguments

ISignalAI [\Single] Signal Condition HighValue LowValue DeltaValue [\DPos] | [\DNeg] Interrupt

[\Single] Data type: *switch*

Specifies whether the interrupt is to occur once or cyclically.

If the argument *Single* is set, the interrupt occurs once at the most. If the argument is omitted, an interrupt will occur each time its condition is satisfied.

Signal Data type: *signalai*

The name of the signal that is to generate interrupts.

Condition Data type: *aiotrigg*

Specifies how *HighValue* and *LowValue* define the condition to be satisfied:

- AIO_ABOVE_HIGH:logical value of the signal is above HighValue
- AIO_BELOW_HIGH:logical value of the signal is below HighValue
- AIO_ABOVE_LOW:logical value of the signal is above LowValue
- AIO_BELOW_LOW:logical value of the signal is below LowValue
- AIO_BETWEEN:logical value of the signal is between LowValue and HighValue
- AIO_OUTSIDE:logical value of the signal is above HighValue or below LowValue
- AIO_ALWAYS:independently of HighValue and LowValue

HighValue Data type: *num*

High logical value to define the condition.

LowValue Data type: *num*

Low logical value to define the condition.

DeltaValue Data type: *num*

Defines the minimum logical signal difference before generation of a new interrupt. The current signal value compared to the stored reference value must be greater than the specified *DeltaValue* before generation of a new interrupt.

[\DPos] Data type: *switch*

Specifies that only positive logical signal differences will give new interrupts.

[\DNeg] Data type: *switch*

Specifies that only negative logical signal differences will give new interrupts.

If none of *\DPos* and *\DNeg* argument is used, both positive and negative differences will generate new interrupts.

Interrupt Data type: *intnum*

The interrupt identity. This interrupt should have previously been connected to a trap routine by means of the instruction CONNECT.

Program execution

When the signal fulfils the specified conditions (both *Condition* **and** *DeltaValue*), a call is made to the corresponding trap routine. When this has been executed, program execution continues from where the interrupt occurred.

Conditions for interrupt generation

Before the interrupt subscription is ordered, each time the signal is sampled, the value of the signal is read, saved, and later used as a reference value for the *DeltaValue* condition.

At the interrupt subscription time, if specified *DeltaValue* = 0 **and** after the interrupt subscription time always at each time the signal is sampled, its value is then compared to *HighValue* and *LowValue* according to *Condition* and with consideration to *DeltaValue*, to generate or not generate an interrupt. If the new read value satisfies the specified *HighValue* and *LowValue Condition*, but its difference compared to the last stored reference value is less or equal to the *DeltaValue* argument, no interrupt occurs. If the signal difference is not in the specified direction, no interrupts will occur. (argument *\DPos* or *\DNeg*).

The stored reference value for the *DeltaValue* condition is updated with a newly read value for later use at any sample, if the following conditions are satisfied:

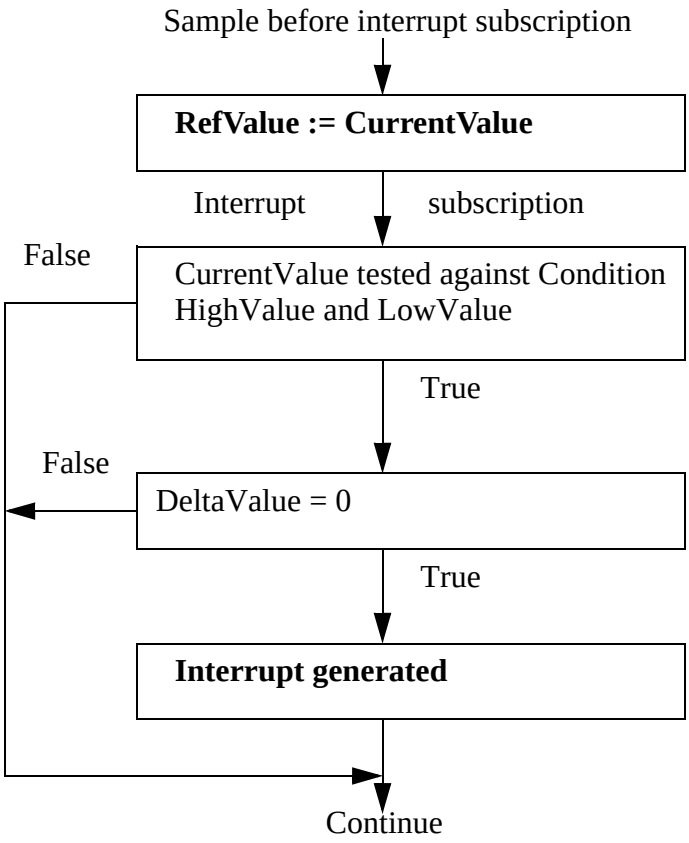
- Argument *Condition* with specified *HighValue* and *LowValue* (within limits)
- Argument *DeltaValue* (sufficient signal change in any direction, independently of specified switch *\DPos* or *\DNeg*)

The reference value is only updated at the sample time, not at the interrupt subscription time.

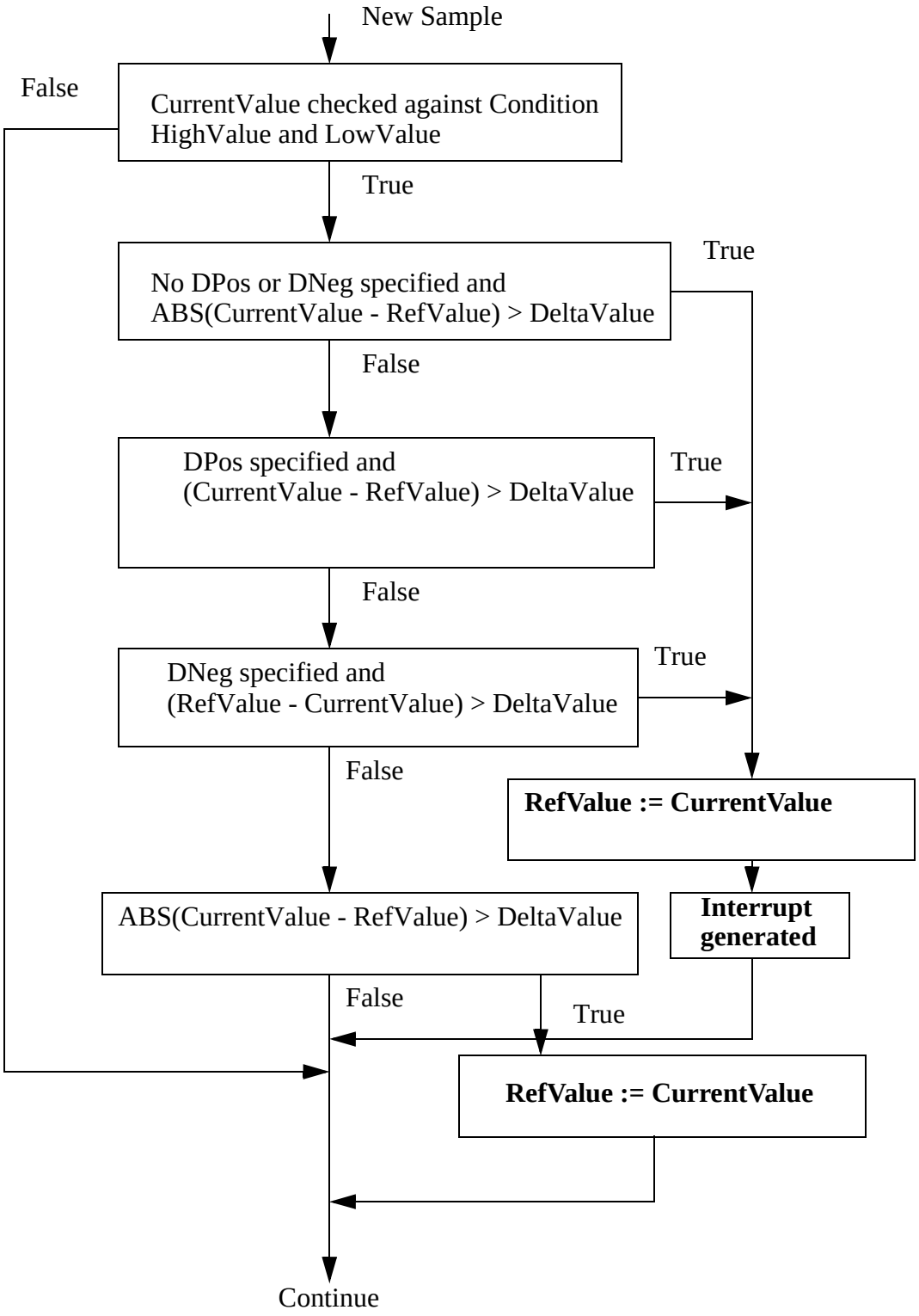
An interrupt is also generated at the sample for update of the reference value, if the direction of the signal difference is in accordance with the specified argument (any direction, *\DPos* or *\DNeg*).

When the *\Single* switch is used, only one interrupt at the most will be generated. If the switch *\Single* (cyclic interrupt) is not used, a new test of the specified conditions (both *Condition* **and** *DeltaValue*) is made at every sample of the signal value, compared to the current signal value and the last stored reference value, to generate or not generate an interrupt.

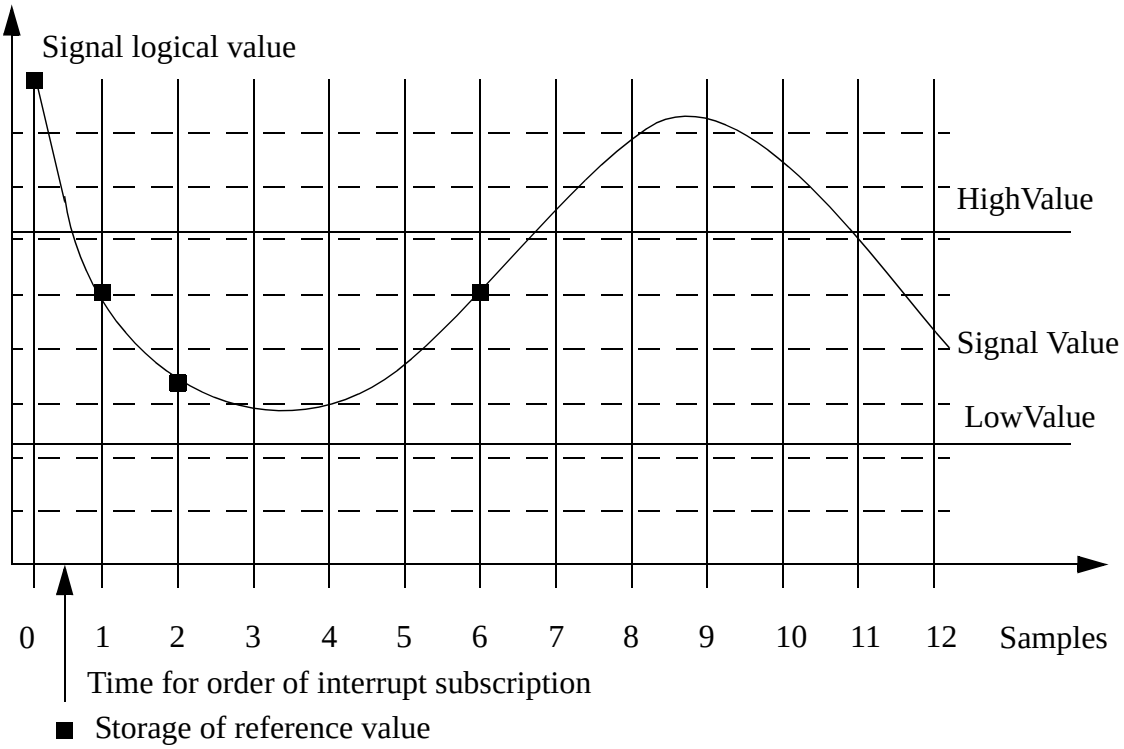
Condition for interrupt generation at interrupt subscription time



Condition for interrupt generation at each sample after interrupt subscription



Example 1 of interrupt generation


Signal logical value
HighValue
Signal Value
LowValue
0 1 2 3 4 5 6 7 8 9 10 11 12 Samples
Time for order of interrupt subscription
Storage of reference value

Assuming the interrupt is ordered between sample 0 and 1, the following instruction will give the following results:

ISignalAI ai1, AIO_BETWEEN, 6.1, 2,2, 1.0, sig1int;

sample 1 will generate an interrupt, because the signal value is between *High-Value* and *LowValue* and the signal difference compared to sample 0 is more than *DeltaValue*.

sample 2 will generate an interrupt, because the signal value is between *High-Value* and *LowValue* and the signal difference compared to sample 1 is more than *DeltaValue*.

samples 3, 4, 5 will not generate any interrupt, because the signal difference is less than *DeltaValue*.

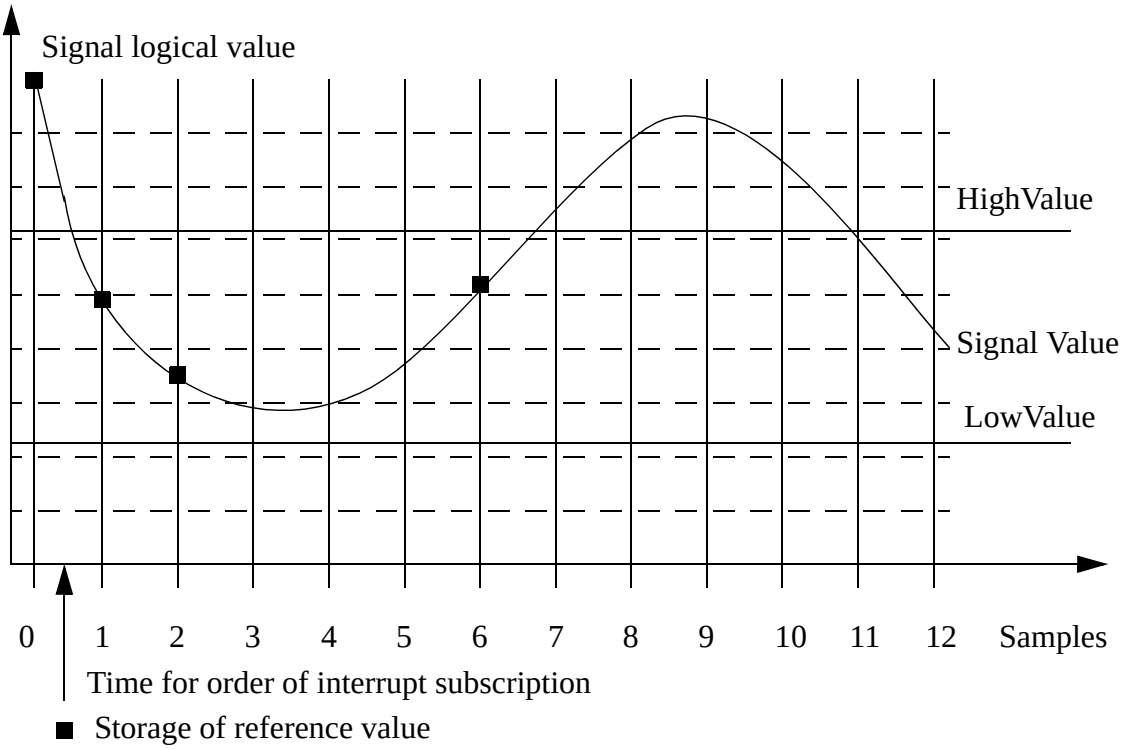
sample 6 will generate an interrupt.

samples 7 to 10 will not generate any interrupt, because the signal is above *HighValue*

sample 11 will not generate any interrupt, because the signal difference compared to sample 6 is equal to *DeltaValue*.

sample 12 will not generate any interrupt, because the signal difference compared to sample 6 is less than *DeltaValue*.

Example 2 of interrupt generation



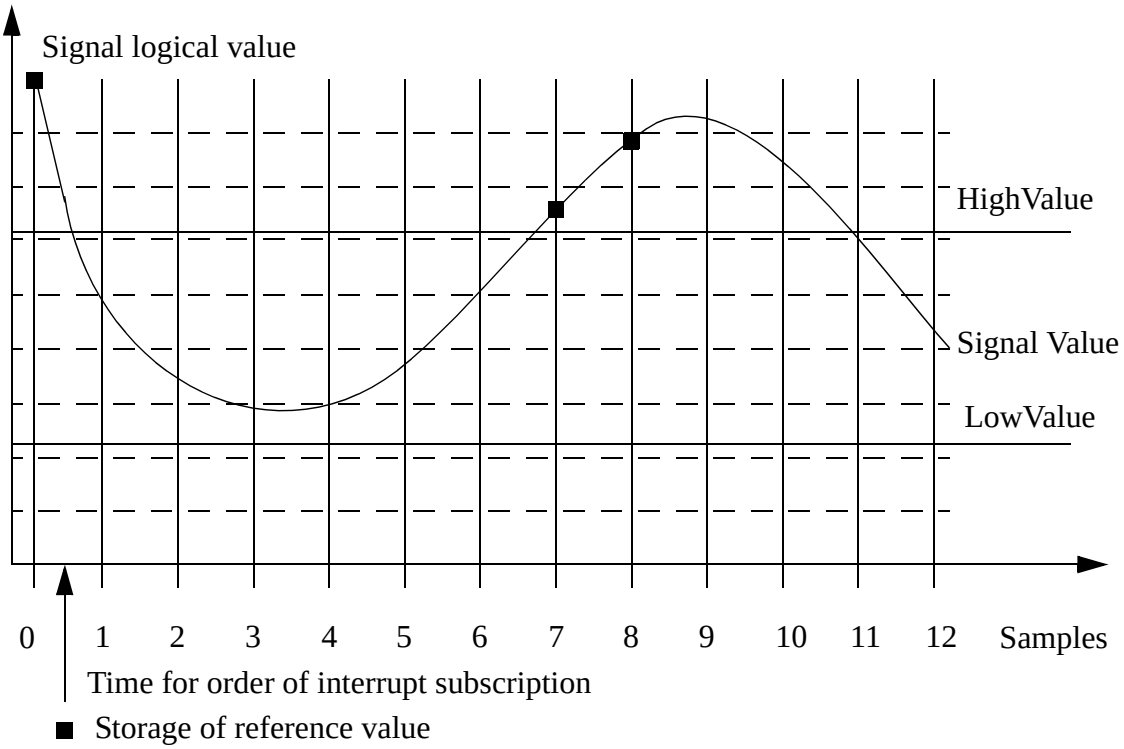
Assuming the interrupt is ordered between sample 0 and 1, the following instruction will give the following results:

ISignalAI ai1, AIO_BETWEEN, 6.1, 2,2, 1.0 \DPos, sig1int;

A new reference value is stored at sample 1 and 2, because the signal is within limits and the absolute signal difference between the current value and the last stored reference value is greater than 1.0.
No interrupt will be generated because the signal changes are in the negative direction.

sample 6 will generate an interrupt, because the signal value is between *High-Value* and *LowValue* and the signal difference in the positive direction compared to sample 2 is more than *DeltaValue*.

Example 3 of interrupt generation


Signal logical value
HighValue
Signal Value
LowValue
0 1 2 3 4 5 6 7 8 9 10 11 12 Samples
Time for order of interrupt subscription
Storage of reference value

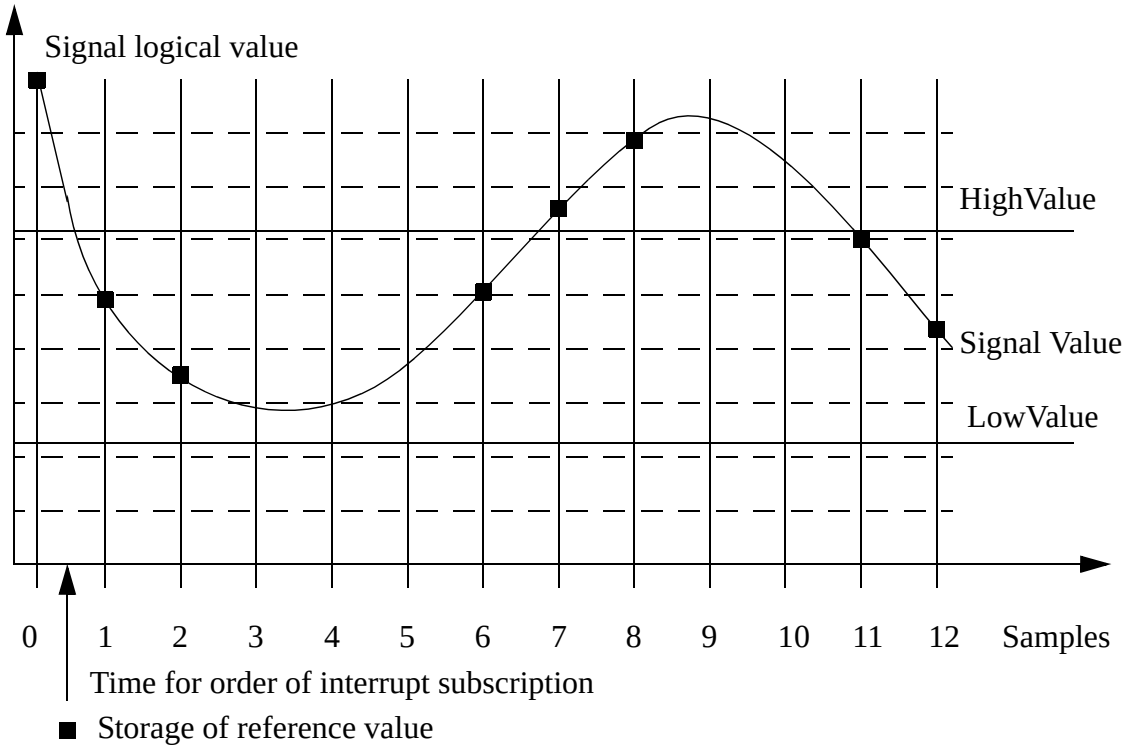
Assuming the interrupt is ordered between sample 0 and 1, the following instruction will give the following results:

ISignalAI \Single, ai1, AIO_OUTSIDE, 6.1, 2,2, 1.0 \DPos, sig1int;

A new reference value is stored at sample 7, because the signal is within limits and the absolute signal difference between the current value and the last stored reference value is greater than 1.0

sample 8 will generate an interrupt, because the signal value is above *HighValue* and the signal difference in the positive direction compared to sample 7 is more than *DeltaValue*.

Example 4 of interrupt generation


Signal logical value
HighValue
Signal Value
LowValue
0 1 2 3 4 5 6 7 8 9 10 11 12 Samples
Time for order of interrupt subscription
Storage of reference value

Assuming the interrupt is ordered between sample 0 and 1, the following instruction will give the following results:

ISignalAI ai1, AIO_ALWAYS, 6.1, 2,2, 1.0 \DPos, sig1int;

A new reference value is stored at sample 1 and 2, because the signal is within limits and the absolute signal difference between the current value and the last stored reference value is greater than 1.0

sample 6 will generate an interrupt, because the signal difference in the positive direction compared to sample 2 is more than *DeltaValue*.

sample 7 and 8 will generate an interrupt, because the signal difference in the positive direction compared to previous sample is more than *DeltaValue*.

A new reference value is stored at sample 11 and 12, because the signal is within limits and the absolute signal difference between the current value and the last stored reference value is greater than 1.0

Error handling

If there is a subscription of interrupt on an analog input signal, an interrupt will be given for every change in the analog value that satisfies the condition specified when ordering the interrupt subscription. If the analog value is noisy, many interrupts can be generated, even if only one or two bits in the analog value are changed.

To avoid generating interrupts for small changes of the analog input value, set the *DeltaValue* to a level greater than 0. Then no interrupts will be generated until a change of the analog value is greater than the specified *DeltaValue*.

Limitations

The *HighValue* and *LowValue* arguments should be in the range: logical maximum value, logical minimum value defined for the signal.

HighValue must be above *LowValue*.

DeltaValue must be 0 or positive.

The limitations for the interrupt identity are the same as for *ISignalDI*.

Syntax

```
ISignalAI
   [ ’\’Single’,’]
   [ Signal’:=’ ]<variable (VAR) of signalai>’,’
   [ Condition’:=’ ]<expression (IN) of aiotrigg>’,’
   [ HighValue’:=’ ]<expression (IN) of num>’,’
   [ LowValue’:=’ ]<expression (IN) of num>’,’
   [ DeltaValue’:=’ ]<expression (IN) of num>
   [ ’\’DPos] | [ ’\’DNeg] ’,’
   [ Interrupt’:=’ ]<variable (VAR) of intnum>’;’
```

Related information

	Described in:
Summary of interrupts	RAPID Summary - Interrupts
Definition of constants	Data Types - aiotrigg
Interrupt from analog output signal	Instructions - ISignalAO
Interrupt from digital input signal	Instructions - ISignalDI
Interrupt from digital output signal	Instructions - ISignalDO
More information on interrupt management	Basic Characteristics - Interrupts
More examples	Data Types - intnum
Related system parameters (filter)	System Parameters - IO Signals

ISignalAO - Interrupts from analog output signal

ISignalAO (Interrupt Signal Analog Output) is used to order and enable interrupts from an analog output signal.

Example

```
VAR intnum sig1int;
CONNECT sig1int WITH iroutine1;
ISignalAO \Single, ao1, AIO_BETWEEN, 1.5, 0.5, 0, sig1int;
```

Orders an interrupt which is to occur the first time the logical value of the analog output signal *ao1* is between *0.5* and *1.5*. A call is then made to the *iroutine1* trap routine.

```
ISignalAO ao1, AIO_BETWEEN, 1.5, 0.5, 0.1, sig1int;
```

Orders an interrupt which is to occur each time the logical value of the analog output signal *ao1* is between *0.5* and *1.5*, and the absolute signal difference compared to the previous stored reference value is bigger than 0.1.

```
ISignalAO ao1, AIO_OUTSIDE, 1.5, 0.5, 0.1, sig1int;
```

Orders an interrupt which is to occur each time the logical value of the analog output signal *ao1* is lower than *0.5* or higher than *1.5*, and the absolute signal difference compared to the previous stored reference value is bigger than 0.1.

Arguments

ISignalAO [\Single] Signal Condition HighValue LowValue DeltaValue [\DPos] | [\DNeg] Interrupt

[\Single] Data type: *switch*

Specifies whether the interrupt is to occur once or cyclically.

If the argument *Single* is set, the interrupt occurs once at the most. If the argument is omitted, an interrupt will occur each time its condition is satisfied.

Signal Data type: *signalao*

The name of the signal that is to generate interrupts.

Condition Data type: *aiotrigg*

Specifies how *HighValue* and *LowValu*e define the condition to be satisfied:

- AIO_ABOVE_HIGH:logical value of the signal is above HighValue
- AIO_BELOW_HIGH:logical value of the signal is below HighValue
- AIO_ABOVE_LOW:logical value of the signal is above LowValue
- AIO_BELOW_LOW:logical value of the signal is below LowValue
- AIO_BETWEEN:logical value of the signal is between LowValue and HighValue
- AIO_OUTSIDE:logical value of the signal is above HighValue or below LowValue
- AIO_ALWAYS:independently of HighValue and LowValue

HighValue Data type: *num*

High logical value to define the condition.

LowValue Data type: *num*

Low logical value to define the condition.

DeltaValue Data type: *num*

Defines the minimum logical signal difference before generation of a new interrupt. The current signal value compared to the previous stored reference value must be greater than the specified *DeltaValue* before generation of a new interrupt.

[\DPos] Data type: *switch*

Specifies that only positive logical signal differences will give new interrupts.

[\DNeg] Data type: *switch*

Specifies that only negative logical signal differences will give new interrupts.

If neither of the *DPos* and *DNeg* arguments are used, both positive and negative differences will generate new interrupts.

Interrupt Data type: *intnum*

The interrupt identity. This interrupt should have previously been connected to a trap routine by means of the instruction CONNECT.

Program execution

See instruction *ISignalAI* for information about:

- Program execution
- Condition for interrupt generation
- More examples

Same principles are valid for *ISignalAO* as for *ISignalAI*.

Limitations

The *HighValue* and *LowValue* arguments should be in the range: logical maximum value, logical minimum value, defined for the signal.

HighValue must be above *LowValue*.

DeltaValue must be 0 or positive.

The limitations for the interrupt identity are the same as for *ISignalDO*.

Syntax

```
ISignalAO
   [ '\'Single',']
   [ Signal':=' ]<variable (VAR) of signalao>','
   [ Condition':=' ]<expression (IN) of aiotrigg>','
   [ HighValue':=' ]<expression (IN) of num>','
   [ LowValue':=' ]<expression (IN) of num>','
   [ DeltaValue':=' ]<expression (IN) of num>
   [ '\'DPos] | [ '\'DNeg] ','
   [ Interrupt':=' ]<variable (VAR) of intnum>';'
```

Related information

	Described in:
Summary of interrupts	RAPID Summary - Interrupts
Definition of constants	Data Types - aiotrigg
Interrupt from analog input signal	Instructions - ISignalAI
Interrupt from digital input signal	Instructions - ISignalDI
Interrupt from digital output signal	Instructions - ISignalDO
More information on interrupt management	Basic Characteristics - Interrupts
More examples	Data Types - intnum
Related system parameters (filter)	System Parameters - IO Signals

ISignalDI - Orders interrupts from a digital input signal

ISignalDI (Interrupt Signal Digital In) is used to order and enable interrupts from a digital input signal.

Examples

VAR intnum sig1int;
CONNECT sig1int WITH iroutine1;
ISignalDI di1,1,sig1int;

Orders an interrupt which is to occur each time the digital input signal *di1* is set to *1*. A call is then made to the *iroutine1* trap routine.

ISignalDI di1,0,sig1int;

Orders an interrupt which is to occur each time the digital input signal *di1* is set to *0*.

ISignalDI \Single, di1,1,sig1int;

Orders an interrupt which is to occur only the first time the digital input signal *di1* is set to *1*.

Arguments

ISignalDI [\Single] Signal TriggValue Interrupt

[\Single] **Data type:** *switch*

Specifies whether the interrupt is to occur once or cyclically.

If the argument *Single* is set, the interrupt occurs once at the most. If the argument is omitted, an interrupt will occur each time its condition is satisfied.

Signal Data type: *signaldi*

The name of the signal that is to generate interrupts.

TriggValue Data type: *dionum*

The value to which the signal must change for an interrupt to occur.

The value is specified as 0 or 1 or as a symbolic value (e.g. *high/low*). The signal is edge-triggered upon changeover to 0 or 1.

TriggValue 2 or symbolic value *edge* can be used for generation of interrupts on both positive flank (0 -> 1) and negative flank (1 -> 0).

Interrupt Data type: *intnum*

The interrupt identity. This should have previously been connected to a trap routine by means of the instruction *CONNECT.*

Program execution

When the signal assumes the specified value, a call is made to the corresponding trap routine. When this has been executed, program execution continues from where the interrupt occurred.

If the signal changes to the specified value before the interrupt is ordered, no interrupt occurs (see Figure 9).

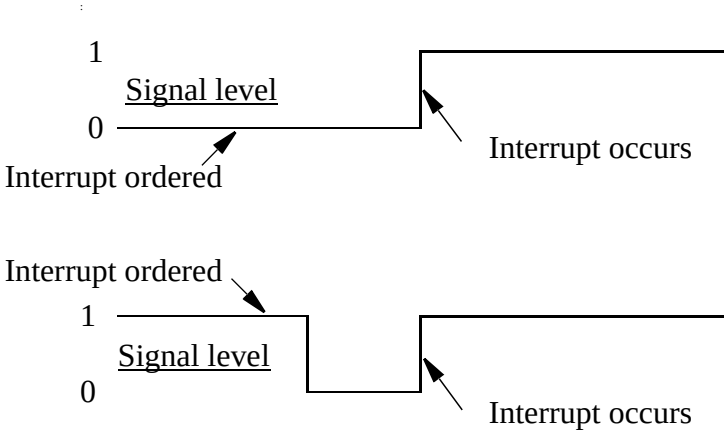


Figure 9 Interrupts from a digital input signal at signal level 1.

Limitations

The same variable for interrupt identity cannot be used more than once, without first deleting it. Interrupts should therefore be handled as shown in one of the alternatives below.

```
PROC main ( )
   VAR intnum sig1int;
   CONNECT sig1int WITH iroutine1;
   ISignalDI di1, 1, sig1int;
   WHILE TRUE DO
   :
   :
   ENDWHILE
ENDPROC
```

All activation of interrupts is done at the beginning of the program. These instructions are then kept outside the main flow of the program.

```
PROC main ( )
   VAR intnum sig1int;
   CONNECT sig1int WITH iroutine1;
   ISignalDI di1, 1, sig1int;
   :
   :
   IDelete sig1int;
ENDPROC
```

The interrupt is deleted at the end of the program, and is then reactivated. It should be noted, in this case, that the interrupt is inactive for a short period.

Syntax

```
ISignalDI
   [ '\' Single',']
   [ Signal ':=' ] < variable (VAR) of signaldi > ','
   [ TriggValue ':=' ] < expression (IN) of dionum >','
   [ Interrupt ':=' ] < variable (VAR) of intnum > ';'
```

Related information

	Described in:
Summary of interrupts	RAPID Summary - Interrupts
Interrupt from an output signal	Instructions - ISignalDO
More information on interrupt management	Basic Characteristics - Interrupts
More examples	Data Types - intnum

ISignalDO - Interrupts from a digital output signal

ISignalDO (Interrupt Signal Digital Out) is used to order and enable interrupts from a digital output signal.

Examples

VAR intnum sig1int;
CONNECT sig1int WITH iroutine1;
ISignalDO do1,1,sig1int;

Orders an interrupt which is to occur each time the digital output signal *do1* is set to *1*. A call is then made to the *iroutine1* trap routine.

ISignalDO do1,0,sig1int;

Orders an interrupt which is to occur each time the digital output signal *do1* is set to *0*.

ISignalDO\Single, do1,1,sig1int;

Orders an interrupt which is to occur only the first time the digital output signal *do1* is set to *1*.

Arguments

ISignalDO [\Single] Signal TriggValue Interrupt

[\Single] **Data type:** *switch*

Specifies whether the interrupt is to occur once or cyclically.

If the argument *Single* is set, the interrupt occurs once at the most. If the argument is omitted, an interrupt will occur each time its condition is satisfied.

Signal Data type: *signaldo*

The name of the signal that is to generate interrupts.

TriggValue Data type: *dionum*

The value to which the signal must change for an interrupt to occur.

The value is specified as 0 or 1 or as a symbolic value (e.g. *high/low*). The signal is edge-triggered upon changeover to 0 or 1.

TriggValue 2 or symbolic value *edge* can be used for generation of interrupts on both positive flank (0 -> 1) and negative flank (1 -> 0).

Interrupt Data type: *intnum*

The interrupt identity. This should have previously been connected to a trap routine by means of the instruction *CONNECT.*

Program execution

When the signal assumes the specified value 0 or 1, a call is made to the corresponding trap routine. When this has been executed, program execution continues from where the interrupt occurred.

If the signal changes to the specified value before the interrupt is ordered, no interrupt occurs (see Figure 10).

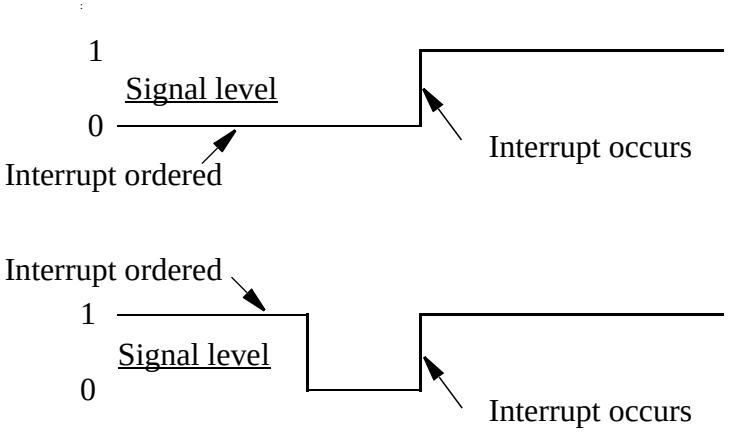


Figure 10 Interrupts from a digital output signal at signal level 1.

Limitations

The same variable for interrupt identity cannot be used more than once, without first deleting it. Interrupts should therefore be handled as shown in one of the alternatives below.

```
VAR intnum sig1int;

PROC main ( )
   CONNECT sig1int WITH iroutine1;
   ISignalDO do1, 1, sig1int;
   WHILE TRUE DO
   :
   :
   ENDWHILE
ENDPROC
```

All activation of interrupts is done at the beginning of the program. These instructions are then kept outside the main flow of the program.

```
PROC main ( )
   VAR intnum sig1int;
   CONNECT sig1int WITH iroutine1;
   ISignalDO do1, 1, sig1int;
   :
   :
   IDelete sig1int;
ENDPROC
```

The interrupt is deleted at the end of the program, and is then reactivated. It should be noted, in this case, that the interrupt is inactive for a short period.

Syntax

```
ISignalDO
   [ '\' Single',']
   [ Signal ':=' ] < variable (VAR) of signaldo > ','
   [ TriggValue ':=' ] < expression (IN) of dionum >','
   [ Interrupt ':=' ] < variable (VAR) of intnum > ';'
```

Related information

	Described in:
Summary of interrupts	RAPID Summary - Interrupts
Interrupt from an input signal	Instructions - ISignalDI
More information on interrupt management	Basic Characteristics- Interrupts
More examples	Data Types - intnum

ISignalGI - Orders interrupts from a group of digital input signals

ISignalGI (Interrupt Signal Group Digital In) is used to order and enable interrupts from a group of digital input signals.

Examples

```
VAR intnum sig1int;
CONNECT sig1int WITH iroutine1;
ISignalGI gi1,sig1int;
```

Orders an interrupt when a digital input group signal change value.

Arguments

ISignalGI [\Single] Signal Interrupt

[\Single] Data type: *switch*

Specifies whether the interrupt is to occur once or cyclically.

If the argument *Single* is set, the interrupt occurs once at the most. If the argument is omitted, an interrupt will occur each time its condition is satisfied.

Signal Data type: *signalgi*

The name of the group input signal that generate interrupts.

Interrupt Data type: *intnum*

The interrupt identity. This should have previously been connected to a trap routine by means of the instruction *CONNECT.*

Program execution

When the group signal change value, a call is made to the corresponding trap routine. When this has been executed, program execution continues from where the interrupt occurred.

If the signal changes before the interrupt is ordered, no interrupt occurs.

Limitations

Maximum number of signals that can be used for a group is 23. This limitation is valid for all instructions and functions using group signals.

Numeric value condition can not be used in the instruction to specify that an interrupt should occur on changes to that specific value. This must be handled in the user program, by reading the group signal value at execution of the TRAP.

The interrupts are generated as bit interrupts, e.g. interrupts on single digital input signal change within the group. If the bits in the group signal change value with a delay between settings, several interrupts will be generated. Knowledege about how the I/O board works is necessary to get right functionality when using *ISignalGI*. If several interrupts are generated at group input settings, use in stead *ISignalDI* on a strobe signal that are set when all bits in the group signal has been set.

The same variable for interrupt identity cannot be used more than once, without first deleting it. Interrupts should therefore be handled as shown in one of the alternatives below.

```
PROC main ( )
   VAR intnum sig1int;
   CONNECT sig1int WITH iroutine1;
   ISignalGI gi1, sig1int;
   WHILE TRUE DO
   :
   :
   ENDWHILE
ENDPROC
```

All activation of interrupts is done at the beginning of the program. These instructions are then kept outside the main flow of the program.

```
PROC main ( )
   VAR intnum sig1int;
   CONNECT sig1int WITH iroutine1;
   ISignalGI gi1, sig1int;
   :
   :
   IDelete sig1int;
ENDPROC
```

The interrupt is deleted at the end of the program, and is then reactivated. It should be noted, in this case, that the interrupt is inactive for a short period.

Syntax

```
ISignalGI
   [ ’\’ Single’,’]
   [ Signal ’:=’ ] < variable (VAR) of signalgi > ’,’
   [ Interrupt ’:=’ ] < variable (VAR) of intnum > ’;’
```

Related information

	Described in:
Summary of interrupts	RAPID Summary - Interrupts
Interrupt from an input signal	Instructions - ISignalDI
Interrupt from group output signals	Instructions - ISignalGO
More information on interrupt management	Basic Characteristics - Interrupts
More examples	Data Types - intnum

ISignalGO - Orders interrupts from a group of digital output signals

ISignalGO (Interrupt Signal Group Digital Out) is used to order and enable interrupts from a group of digital output signals.

Examples

```
VAR intnum sig1int;
CONNECT sig1int WITH iroutine1;
ISignalGO go1,sig1int;
```

Orders an interrupt when a digital output group signal change value.

Arguments

ISignalGO [\Single] Signal Interrupt

[\Single] Data type: *switch*

Specifies whether the interrupt is to occur once or cyclically.

If the argument *\Single* is set, the interrupt occurs once at the most. If the argument is omitted, an interrupt will occur each time its condition is satisfied.

Signal Data type: *signalgo*

The name of the group output signal that generate interrupts.

Interrupt Data type: *intnum*

The interrupt identity. This should have previously been connected to a trap routine by means of the instruction *CONNECT.*

Program execution

When the group signal change value, a call is made to the corresponding trap routine. When this has been executed, program execution continues from where the interrupt occurred.

If the signal changes before the interrupt is ordered, no interrupt occurs.

Limitations

Maximum number of signals that can be used for a group is 23. This limitation is valid for all instructions and functions using group signals.

Numeric value condition can not be used in the instruction to specify that an interrupt should occur on changes to that specific value. This must be handled in the user program, by reading the group signal value at execution of the TRAP.

The same variable for interrupt identity cannot be used more than once, without first deleting it. Interrupts should therefore be handled as shown in one of the alternatives below.

```
PROC main ( )
   VAR intnum sig1int;
   CONNECT sig1int WITH iroutine1;
   ISignalGO go1, sig1int;
   WHILE TRUE DO
   :
   :
   ENDWHILE
ENDPROC
```

All activation of interrupts is done at the beginning of the program. These instructions are then kept outside the main flow of the program.

```
PROC main ( )
   VAR intnum sig1int;
   CONNECT sig1int WITH iroutine1;
   ISignalGO go1, sig1int;
   :
   :
   IDelete sig1int;
ENDPROC
```

The interrupt is deleted at the end of the program, and is then reactivated. It should be noted, in this case, that the interrupt is inactive for a short period.

Syntax

```
ISignalGO
   [ '\' Single',']
   [ Signal ':=' ] < variable (VAR) of signalgo > ','
   [ Interrupt ':=' ] < variable (VAR) of intnum > ';'
```

Related information

	Described in:
Summary of interrupts	RAPID Summary - Interrupts
Interrupt from an output signal	Instructions - ISignalDO
Interrupt from group input signals	Instructions - ISignalGI
More information on interrupt management	Basic Characteristics - Interrupts
More examples	Data Types - intnum

ISleep - Deactivates an interrupt

ISleep (Interrupt Sleep) is used to deactivate an individual interrupt temporarily.

During the deactivation time, any generated interrupts of the specified type are discarded without any trap execution.

Example

ISleep sig1int;

The interrupt *sig1int* is deactivated.

Arguments

ISleep Interrupt

Interrupt Data type: *intnum*

The variable (interrupt identity) of the interrupt.

Program execution

Any generated interrupts of the specified type are discarded without any trap execution, until the interrupt has been re-activated by means of the instruction *IWatch*. Interrupts which are generated while *ISleep* is in effect are ignored.

Example

```
VAR intnum timeint;
CONNECT timeint WITH check_serialch;
ITimer 60, timeint;
.
ISleep timeint;
WriteBin ch1, buffer, 30;
IWatch timeint;
.
TRAP check_serialch
    WriteBin ch1, buffer, 1;
    IF ReadBin(ch1\Time:=5) < 0 THEN
        TPWrite “The serial communication is broken”;
        EXIT;
    ENDIF
```

```
ENDTRAP
```

Communication across the ch1 serial channel is monitored by means of interrupts which are generated every *60* seconds. The trap routine checks whether the communication is working. When, however, communication is in progress, these interrupts are not permitted.

Error handling

Interrupts which have neither been ordered nor enabled are not permitted. If the interrupt number is unknown, the system variable ERRNO will be set to ERR_UNKINO (see “Data types - errnum”). The error can be handled in the error handler.

Syntax

ISleep
[Interrupt ‘:=’] < variable (**VAR**) of *intnum* > ‘;’

Related information

	Described in:
Summary of interrupts	RAPID Summary - Interrupts
Enabling an interrupt	Instructions - IWatch
Disabling all interrupts	Instructions - IDisable
Cancelling an interrupt	Instructions - IDelete

IsPers - Is persistent

IsPers is used to test if a data object is a persistent variable or not.

Example

```
PROC procedure1 (INOUT num parameter1)
   IF IsVar(parameter1) THEN
      ! For this call reference to a variable
      ...
   ELSEIF IsPers(parameter1) THEN
      ! For this call reference to a persistent variable
      ...
   ELSE
      ! Should not happen
      EXIT;
   ENDIF
ENDPROC
```

The procedure *procedure1* will take different actions depending on whether the actual parameter *parameter1* is a variable or a persistent variable.

Return value Data type: *bool*

TRUE if the tested actual INOUT parameter is a persistent variable.
FALSE if the tested actual INOUT parameter is not a persistent variable.

Arguments

IsPers (DatObj)

DatObj (*Data Object*) Data type: any type

The name of the formal INOUT parameter.

Syntax

IsPers’(’
[DatObj ’:=’] < var or pers (**INOUT**) of any type > ’)’

A function with a return value of the data type *bool*.

Related information

	Described in:
Test if variable	Function - IsVar
Types of parameters (access modes)	RAPID Characteristics - Routines

ITimer - Orders a timed interrupt

ITimer (Interrupt Timer) is used to order and enable a timed interrupt.

This instruction can be used, for example, to check the status of peripheral equipment once every minute.

Examples

VAR intnum timeint;
CONNECT timeint WITH iroutine1;
ITimer 60, timeint;

Orders an interrupt that is to occur cyclically every *60* seconds. A call is then made to the trap routine *iroutine1*.

ITimer \Single, 60, timeint;

Orders an interrupt that is to occur once, after *60* seconds.

Arguments

ITimer [\Single] Time Interrupt

[\Single] **Data type:** *switch*

Specifies whether the interrupt is to occur once or cyclically.

If the argument *Single* is set, the interrupt occurs only once. If the argument is omitted, an interrupt will occur each time at the specified time.

Time Data type: *num*

The amount of time that must lapse before the interrupt occurs.

The value is specified in second if *Single* is set, this time may not be less than 0.05 seconds. The corresponding time for cyclical interrupts is 0.25 seconds.

Interrupt Data type: *intnum*

The variable (interrupt identity) of the interrupt. This should have previously been connected to a trap routine by means of the instruction *CONNECT.*

Program execution

The corresponding trap routine is automatically called at a given time following the interrupt order. When this has been executed, program execution continues from where

the interrupt occurred.

If the interrupt occurs cyclically, a new computation of time is started from when the interrupt occurs.

Example

```
VAR intnum timeint;
CONNECT timeint WITH check_serialch;
ITimer 60, timeint;
.
TRAP check_serialch
   WriteBin ch1, buffer, 1;
   IF ReadBin(ch1\Time:=5) < 0 THEN
      TPWrite “The serial communication is broken”;
      EXIT;
   ENDIF
ENDTRAP
```

Communication across the ch1 serial channel is monitored by means of interrupts which are generated every *60* seconds. The trap routine checks whether the communication is working. If it is not, program execution is interrupted and an error message appears.

Limitations

The same variable for interrupt identity cannot be used more than once, without being first deleted. See Instructions - *ISignalDI*.

Syntax

```
ITimer
   [ ’\’Single ’,’]
   [ Time ’:=’ ] < expression (IN) of num >’,’
   [ Interrupt ’:=’ ] < variable (VAR) of intnum > ’;’
```

Related information

	Described in:
Summary of interrupts	RAPID Summary - Interrupts
More information on interrupt management	Basic Characteristics- Interrupts

IVarValue - orders a variable value interrupt

IVarVal(Interrupt Variable Value) is used to order and enable an interrupt when the value of a variable accessed via the serial sensor interface has been changed.

This instruction can be used, for example, to get seam volume or gap values from a seam tracker.

Examples

```
LOCAL PERS num adtVlt{25}:=[1,1.2,1.4,1.6,1.8,2,2.16667,2.33333,2.5,...];
LOCAL PERS num adptWfd{25}:=[2,2.2,2.4,2.6,2.8,3,3.16667,3.33333,3.5,...];
LOCAL PERS num adptSpd{25}:=10,12,14,16,18,20,21.6667,23.3333,25[,...];
LOCAL CONST num GAP_VARIABLE_NO:=11;
PERS num gap_value;
VAR intnum IntAdap;

PROC main()
! Setup the interrupt. The trap routine AdapTrp will be called
! when the gap variable with number 'GAP_VARIABLE_NO' in
! the sensor interface has been changed. The new value will be available
! in the PERS gp_value variable.
   CONNECT IntAdap WITH AdapTrp;
   IVarValue GAP_VARIABLE_NO, gap_value, IntAdap;

   ! Start welding
   ArcL\On,*,v100,adaptSm,adaptWd,adaptWv,z10,tool\j\Track:=track;
   ArcL\On,*,v100,adaptSm,adaptWd,adaptWv,z10,tool\j\Track:=track;
ENDPROC

TRAP AdapTrap
   VAR num ArrInd;

   !Scale the raw gap value received
   ArrInd:=ArrIndx(gap_value);

   ! Update active welddata PERS variable 'adaptWd' with
   ! new data from the arrays of predefined parameter arrays.
   ! The scaled gap value is used as index in the voltage, wirefeed and speed arrays.
   adaptWd.weld_voltage:=adptVlt{ArrInd};
   adaptWd.weld_wirefeed:=adptWfd{ArrInd};
   adaptWd.weld_speed:=adptSpd{ArrInd};

   !Request a refresh of AW parameters using the new data i adaptWd
   ArcRefresh;
ENDTRAP
```

Arguments

IVarValue VarNo Value, Interrupt

VarNo Data type: *num*

The number of the variable to be supervised.

Value Data type: *num*

A PERS variable which will hold the new value of Varno.

Interrupt Data type: *intnum*

The variable (interrupt identity) of the interrupt. This should have previously been connected to a trap routine by means of the instruction *CONNECT.*

Program execution

The corresponding trap routine is automatically called at a given time following the interrupt order. When this has been executed, program execution continues from where the interrupt occurred.

Limitations

The same variable for interrupt identity cannot be used more than five times, without first being deleted.

Syntax

IVarValue
[VarNo ':='] < expression (**IN**) of *num* >','
[Value ':='] < persistent(**PERS**) of *num* >','
[Interrupt ':='] < variable (**VAR**) of *intnum* > ';'

Related information

	Described in:
Summary of interrupts	RAPID Summary - Interrupts
More information on interrupt management	Basic Characteristics- Interrupts

IWatch - Activates an interrupt

IWatch (Interrupt Watch) is used to activate an interrupt which was previously ordered but was deactivated with *ISleep*.

Example

IWatch sig1int;

The interrupt *sig1int* that was previously deactivated is activated.

Arguments

IWatch Interrupt

Interrupt Data type: *intnum*

Variable (interrupt identity) of the interrupt.

Program execution

Re-activates interrupts of the specified type once again. However, interrupts generated during the time the *ISleep* instruction was in effect, are ignored.

Example

```
VAR intnum sig1int;
CONNECT sig1int WITH iroutine1;
ISignalDI di1,1,sig1int;
.
ISleep sig1int;
weldpart1;
IWatch sig1int;
```

During execution of the *weldpart1* routine, no interrupts are permitted from the signal *di1*.

Error handling

Interrupts which have not been ordered are not permitted. If the interrupt number is unknown, the system variable ERRNO is set to ERR_UNKINO (see “Date types - errnum”). The error can be handled in the error handler.

Syntax

IWatch
[Interrupt ':='] < variable (**VAR**) of *intnum* > ';'

Related information

	Described in:
Summary of interrupts	RAPID Summary - Interrupts
Deactivating an interrupt	Instructions - ISleep

label - Line name

Label is used to name a line in the program. Using the *GOTO* instruction, this name can then be used to move program execution.

Example

```
GOTO next;
   .
next:
```

Program execution continues with the instruction following *next*.

Arguments

Label:

Label Identifier

The name you wish to give the line.

Program execution

Nothing happens when you execute this instruction.

Limitations

The label must not be the same as

- any other label within the same routine,
- any data name within the same routine.

A label hides global data and routines with the same name within the routine it is located in.

Syntax

(EBNF)
<identifier>':'

Related information

	Described in:
Identifiers	Basic Characteristics-Basic Elements
Moving program execution to a label	Instructions - GOTO

Load - Load a program module during execution

Load is used to load a program module into the program memory during execution.

The loaded program module will be added to the already existing modules in the program memory.

A program or system module can be loaded in static (default) or dynamic mode:

Static mode

Table 1 How different operations affects static loaded program or system modules

	Set PP to main from TP	Open new RAPID program
Program Module	Not affected	Unloaded
System Module	Not affected	Not affected

Dynamic mode

Table 2 How different operations affects dynamic loaded program or system modules

	Set PP to main from TP	Open new RAPID program
Program Module	Unloaded	Unloaded
System Module	Unloaded	Unloaded

Both static and dynamic loaded modules can be unloaded by the instruction *UnLoad*.

Example

Load \Dynamic, diskhome \File:="PART_A.MOD";

Load the program module PART_A.MOD from the *diskhome* into the program memory. *diskhome* is a predefined string constant "*HOME*:". Load the program module in the dynamic mode.

Arguments

Load [\Dynamic] FilePath [\File]

[\Dynamic] Data type: *switch*

The switch enables load of a program module in dynamic mode. Otherwise the load is in static mode.

FilePath Data type: *string*

The file path and the file name to the file that will be loaded into the program memory. The file name shall be excluded when the argument *File* is used.

[\File] Data type: *string*

When the file name is excluded in the argument *FilePath* then it must be defined with this argument.

Program execution

Program execution waits for the program module to finish loading before proceeding with the next instruction.

To obtain a good program structure, that is easy to understand and maintain, all loading and unloading of program modules should be done from the main module which is always present in the program memory during execution.

After the program module is loaded it will be linked and initialised. The initialisation of the loaded module sets all variables at module level to their init values. Unresolved references will be accepted if the system parameter for *Tasks* is set (BindRef = NO). However, when the program is started or the FlexPendant function Program/File/Check is used, no check for unresolved references will be done if the parameter BindRef = NO. There will be a run time error on execution of an unresolved reference.

Another way to use references to procedures that are not in the task from the beginning, is to use *Late Binding.* This makes it possible to specify the procedure to call with a string expression, quoted between two % (se example). In this case the *BindRef* parameter could be set to YES (default behaviour). The *Late Binding* way is preferable.

For loading of program that contains a main procedure to a main program (with another main procedure), see example below.

Examples

More general examples

```
Load \Dynamic, "HOME:/DOORDIR/DOOR1.MOD";
```

Loads the program module *DOOR1.MOD* from *HOME:* at the directory *DOORDIR* into the program memory. The program module is loaded in the dynamic mode.

```
Load "HOME:"  \File:="DOORDIR/DOOR1.MOD";
```

Same as above but another syntax, and the module is loaded in the static mode.

```
Load\Dynamic, "HOME:/DOORDIR/DOOR1.MOD";
```

```
%"routine_x"%;
UnLoad "HOME:/DOORDIR/DOOR1.MOD";
```

Program module *DOOR1.MOD*, will be binded during execution (late binding).

Loaded program contains a main procedure

car.prg

```
MODULE car
  PROC main()
    .................
    TEST part
    CASE door_part:
      Load \Dynamic, "HOME:/door.prg";
      %"door:main"%;
      UnLoad "HOME:/door.prg";
    CASE window_part:
      Load \Dynamic, "HOME:/window.prg";
      %"window:main"%;
      UnLoad \Save, "HOME:/window.prg";
    ENDTEST
  ENDPROC
ENDMODULE
```

door.prg

```
MODULE door
  PROC main()
    .................
    .................
  ENDPROC
ENDMODULE
```

window.prg

```
MODULE window
  PROC main()
    ..................
    ..................
  ENDPROC
ENDMODULE
```

The above example shows how You can load program which includes a *main* procedure. This program can have been developed and tested separate and later loaded with *Load* or *StartLoad ... WaitLoad* into the system useing some type of main program framewok. In this example *car.prg*, which load other programs *door.prg* or *window.prg*.

In the program *car.prg* you load *door.prg* or *window.prg* located at "HOME:". Because the *main* procedures in *door.prg* and *window.prg* after the loading are considered **LOCAL** in the module by the system, the procedure calls are made in the following way: %"*door:main"%* or %"*window: main"%*. This syntax is used when you want to get access to **LOCAL** procedures in other modules, in this example procedure *main* in module *door* or module *window.*

Unloading the modules with *\Save* argument, will again make the *main* procedures to be global in the saved program.

If You, when the module *car* or *window* are loaded in the system, set program pointer to *main* from any part of the program, the program pointer will always be set to the global *main* procedure in the main program, *car.prg* in this example.

Limitations

Avoid ongoing robot movements during the loading.

Avoid using the floppy disk for loading since reading from the floppy drive is very time consuming.

Error handling

If the file in the *Load* instructions cannot be found, then the system variable ERRNO is set to ERR_FILNOTFND. If the module already is loaded into the program memory then the system variable ERRNO is set to ERR_LOADED (see "Data types - errnum"). If the module cannot be loaded because the program memory is full, the system variable ERRNO is set to ERR_PRGMEMFULL.
The errors above can be handled in an error handler.

Syntax

Load
[‘\’Dynamic ‘,’]
[FilePath’:=’]<expression (**IN**) of *string*>
[’\’File’:=’ <expression (**IN**) of *string*>]’;’

Related information

	Described in:
Unload a program module	Instructions - UnLoad
Load a program module in parallel	Instructions - StartLoad-WaitLoad
with another program execution	
Accept unresolved references	System Parameters - Controller /Tasks / BindRef

LoadId - Load identification of tool or payload

LoadId (Load Identification) can be used for load identification of tool (also gripper tool if roomfix TCP) or payload (activates with instruction *GripLoad*) by executing a user defined RAPID program.

Note: an easier way to identify the tool loading or payload is to use the interactive dialogue RAPID program *LoadIdentify.* This program can be started from the menu Program Window/Special/Call Service Routine.../LoadIdentify.

Example

```
VAR bool invalid_pos := TRUE;
VAR jointtarget joints;
VAR bool valid_joints{12};
CONST speeddata low_ori_speed := [20, 5, 20, 5];
VAR bool slow_test_flag := TRUE;
PERS tooldata grip3 := [ TRUE, [[97.4, 0, 223.1], [0.924, 0, 0.383 ,0]],
   [0, [0, 0, 0], [1, 0, 0, 0], 0, 0, 0]];

! Check if valid robot type
IF ParIdRobValid(TOOL_LOAD_ID) <> ROB_LOAD_VAL THEN
   EXIT;
ENDIF

! Check if valid robot position
WHILE invalid_pos = TRUE DO
   joints := CJointT();
   IF ParIdPosValid (TOOL_LOAD_ID, joints, valid_joints) = TRUE THEN
      ! Valid position
      invalid_pos := FALSE;
   ELSE
      ! Invalid position
      ! Adjust the position by program movements (horizontal tilt house)
      MoveAbsJ joints, low_ori_speed, fine, tool0;
   ENDIF
ENDWHILE

! Do slow test for check of free working area
IF slow_test_flag = TRUE THEN
   LoadId TOOL_LOAD_ID, MASS_WITH_AX3, grip3 \SlowTest;
ENDIF

! Do measurement and update all load data in grip3
LoadId TOOL_LOAD_ID, MASS_WITH_AX3, grip3;
```

Load identification of tool *grip3*.

Condition

The following conditions should be fulfilled before load measurements with *LoadId*:

- Make sure that all loads are correctly mounted on the robot
- Check whether valid robot type with *ParIdRobValid*
- Check whether valid position with *ParIdPosValid*
  - Axes 3, 5 and 6 not close to their corresponding working range
  - Tilt housing almost horizontal, i.e. that axis 4 is in zero position
- The following data should be defined in system parameters and in arguments to *LoadId* before running *LoadId*:

Table 3 Load identification of tool

Load identification modes / Defined data before LoadId	Moving TCP Mass Known	Moving TCP Mass Unknown	Roomfix TCP Mass Known	Roomfix TCP Mass Unknown
Upper arm load (System parameter)		Defined		Defined
Mass in tool	Defined		Defined	

Table 4 Load identification of payload

Load identification modes / Defined data before LoadId	Moving TCP Mass Known	Moving TCP Mass Unknown	Roomfix TCP Mass Known	Roomfix TCP Mass Unknown
Upper arm load (System parameters)		Defined		Defined
Load data in tool	Defined	Defined	Defined	Defined
Mass in payload	Defined		Defined	
Tool frame in tool	Defined	Defined		
User frame in work object			Defined	Defined
Object frame in work object			Defined	Defined

- Operating mode and speed override:
  - Slow test in manual mode reduced speed
  - Load measurements in automatic mode (or manual mode full speed) with speed override 100%

Arguments

LoadId ParIdType LoadIdType Tool [\PayLoad] [\WObj] [\ConfAngle] [\SlowTest] [\Accuracy]

ParIdType Data type: *paridnum*

Type of parameter identification as defined in the table below.

Table 5

Value	Symbolic constant	Comment
1	TOOL_LOAD_ID	Identify tool load
2	PAY_LOAD_ID	Identify payload (Ref. instruction GripLoad)

LoadIdType Data type: *loadidnum*

Type of load identification as defined in the table below.

Table 6

Value	Symbolic constant	Comment
1	MASS_KNOWN	Known mass in tool or payload respectively. (Mass in specified Tool or PayLoad must be specified)
2	MASS_WITH_AX3	Unknown mass in tool or payload respectively. Identification of mass in tool or payload will be done with movements of axis 3

Tool Data type: *tooldata*

Persistent variable for the tool to be identified.
If argument *PayLoad* specified, the persistent variable for the tool in use.

For load identification of tool, the following arguments *PayLoad* and *WObj* should not be specified.

[\ PayLoad] Data type: *loaddata*

Persistent variable for the payload to be identified.

This option argument must always be specified for load identification of payload.

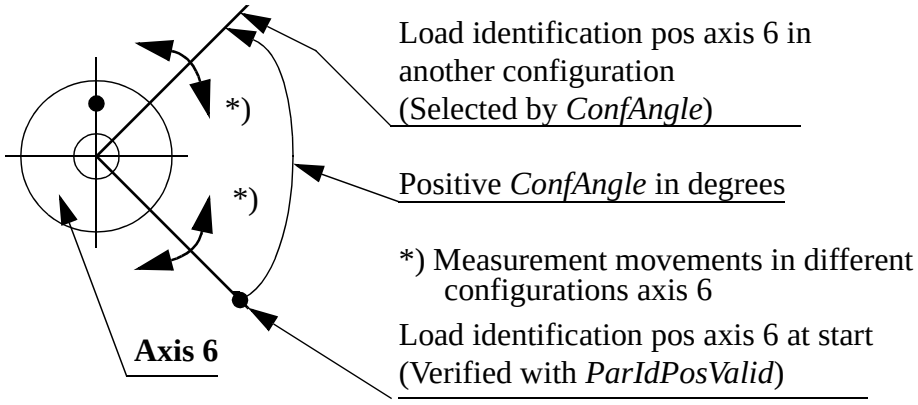
[\ WObj] Data type: *wobjdata*

Persistent variable for the work object in use.

This option argument must always be specified for load identification of payload with roomfix TCP.

[\ ConfAngle] Data type: *num*

Option argument for specification of a specific configuration angle +/- degrees to be used for the parameter identification.


*)
*)
Axis 6
Load identification pos axis 6 in another configuration (Selected by *ConfAngle*)
Positive *ConfAngle* in degrees
*) Measurement movements in different configurations axis 6
Load identification pos axis 6 at start (Verified with *ParIdPosValid*)

Default + 90 degrees if this argument is not specified.
Min. + or - 30 degrees. Optimum + or - 90 degrees.

[\ SlowTest] Data type: *switch*

Option argument to specify whether only slow test for checking of free working area should be done:
- LoadId ... \SlowTest -> Run only slow test
- LoadId ... -> Run only measurement and update tool or payload

[\ Accuracy] Data type: *num*

Variable for output of calculated measurement accuracy in % for the whole load identification calculation (100% means maximum accuracy).

Program execution

The robot will carry out a large number of relative small transport and measurement movements on axes 5 and 6. For identification of mass, movements will also be made with axis 3.

After all measurements, movements, and load calculations, the load data is returned in argument *Tool* or *PayLoad*. The following load data is calculated:

- Mass in kg (if mass is unknown otherwise not affected)
- Centre of gravity x, y, z and axes of moment
- Inertia ix, iy, iz in kgm

Example

```
PERS tooldata grip3 := [ FALSE, [[97.4, 0, 223.1], [0.924, 0, 0.383 ,0]],
   [6, [10, 10, 100], [0.5, 0.5, 0.5, 0.5], 1.2, 2.7, 0.5]];
PERS loaddata piece5 := [ 5, [0, 0, 0], [1, 0, 0, 0], 0, 0, 0];
PERS wobjdata wobj2 := [ TRUE, TRUE, "", [ [34, 0, -45], [0.5, -0.5, 0.5 ,-0.5] ],
   [ [0.56, 10, 68], [0.5, 0.5, 0.5 ,0.5] ] ];
VAR num load_accuracy;

! Do measurement and update all load data except mass in piece5
LoadId PAY_LOAD_ID, MASS_KNOWN, grip3 \PayLoad:=piece5 \WObj:=wobj2
   \Accuracy:=load_accuracy;
TPWrite " Load accuracy for piece5 (%) = " \Num:=load_accuracy;
```

Load identification of payload *piece5* with known mass in installation with roomfix TCP.

Limitations

It is not possible to restart the load identification movements after any type of stop such as program stop, emergency stop or power failure. The load identification movements must be restarted from the beginning again.

Error handling

At any error during execution of the RAPID NOSTEPIN routine *LoadId*, the system variable ERRNO is set to ERR_PID_MOVESTOP, ERR_PID_RAISE_PP or ERR_LOADID_FATAL and the program pointer is raised to the user call of *LoadId*.

Syntax

LoadId
[ParIdType ':='] <expression (**IN**) of *paridnum*> ','
[LoadIdType ':='] <expression (**IN**) of *loadidnum*> ','
[Tool ':='] <persistent (**PERS**) of *tooldata*>
['\' PayLoad ':=' <persistent (**PERS**) of *loaddata*>]
['\' WObj ':=' <persistent (**PERS**) of *wobjdata*>]
['\' ConfAngle ':=' <expression (**IN**) of *num*>]
['\' SlowTest]
['\' Accuracy ':=' <variable (**VAR**) of *num*>] ';'

Related information

	Described in:
Predefined program Load Identify	Calibration - Identification of tool and payload data
Type of parameter identification	Data Types - paridnum
Result of ParIdRobValid	Data Types - paridvalidnum
Type of load identification	Data Types - loadidnum
Valid robot type	Functions - ParIdRobValid
Valid robot position	Functions - ParIdPosValid

MakeDir - Create a new directory

MakeDir is used to create a new directory. The user must have write and execute permission for the parent directory under which the new directory is created.

Examples

MakeDir “HOME:/newdir”;

This example creates a new directory under *HOME:*

Arguments

MakeDir **Path**

Path Data type: *string*

The name of the new directory, specified with full or relative path.

Error handling

If the directory cannot be created, the system variable ERRNO is set to ERR_FILEACC. This error can then be handled in the error handler.

Syntax

MakeDir
[Path’:=’] < expression (**IN**) of *string*>’;’

Related information

	Described in:
Remove a directory	RemoveDir
Remove a file	RemoveFile

ManLoadIdProc - Load identification of IRBP manipulators

ManLoadIdProc (Manipulator Load Identification Procedure) is used for load identification of payload for external manipulators by executing a user defined RAPID program.

This instruction can only be used in the *Main* task or, if in a MultiMove System, in Motion tasks.

Note: an easier way to identify the payload is to use the interactive dialogue RAPID program *ManLoadIdentify.*

Example

```
PERS loaddata myload := [6,[0,0,0],[1,0,0,0],0,0,0];
VAR bool defined;

ActUnit STN1;

ManLoadIdProc \ParIdType := IRBP_L
                \MechUnit := STN1
                \PayLoad := myload
                \ConfigAngle := 60
                \AlreadyActive
                \DefinedFlag := defined;

DeactUnit STN1;
```

Load identification of payload *myload* mounted on the mechanical unit *STN1*. The external manipulator is of type *IRBP-L*. The configuration angle is set to 60 degrees. The manipulator is activated before the load identification and deactivated after. After the identification *myload* will have been updated, and *defined* is set to TRUE.

Arguments

ManLoadIdProc [\ParIdType] [\MechUnit] | [\MechUnitName] [\AxisNumber] [\PayLoad] [\ConfigAngle] [\DeactAll] | [\AlreadyActive] [DefinedFlag]

[\ ParIdType] Data type: *paridnum*

Type of parameter identification. Predefined constants are found under the datatype *paridnum*.

[\ MechUnit] Data type: *mecunit*

Mechanical unit used for the load identification. Can not be used together with argument MechUnitName.

[\ MechUnitName] Data type: *string*

Mechanical unit used for the load identification, given as a string. Can not be used together with argument MechUnit.

[\ AxisNumber] Data type: *num*

Axis number within the mechanical unit, which holds the load to be identified.

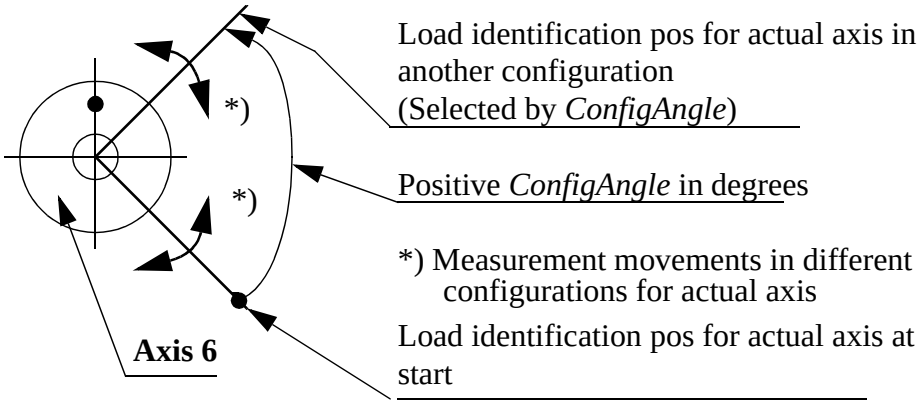
[\ PayLoad] Data type: *loaddata*

Variable for the payload to be identified. The component *mass* must be specified.

This variable will be updated after the identification is done.

[\ ConfigAngle] Data type: *num*

Specification of a specific configuration angle +/- degrees to be used for the parameter identification.


*)
*)
Axis 6
Load identification pos for actual axis in another configuration (Selected by *ConfigAngle*)
Positive *ConfigAngle* in degrees
*) Measurement movements in different configurations for actual axis
Load identification pos for actual axis at start

Min. + or - 30 degrees. Optimum + or - 90 degrees.

[\ DeactAll] Data type: *switch*

If this switch is used all mechanical units known in the system will be deactivated before identification is done. The mechancal unit to identify will then be activated. Can not be used together with argument AlreadyActive.

[\ AlreadyActive] Data type: *switch*

This switch is used if the mechanical unit to identify is active. Can not be used together with argument DeactAll.

[\ DefinedFlag] Data type: *bool*

This argument will be set to TRUE if the identification has been made, FALSE otherwise.

Program Execution

All arguments are optional. If an argument is not given, the user will be asked for the value from the FlexPendant

The user will always be asked to give the mass and, if the manipulator is of type IRBP R, z in mm.

The mechanical unit will carry out a large number of relative small transport and measurement movements.

After all measurements, movements and local calculations, the load data is returned in argument *Payload*, if used. The following load data is calculated

Tabell 7 Calculated load data from load identification of external manipulator

Load identification type/ Calculated load data	IRBP -K	IRBP -L IRBP -C IRBP _T	IRBP -R	IRBP -A IRBP -B IRBP -D
Parameter PayLoad - cog.x, cog.y, cog.z in loaddata in mm	cog.x cog.y	cog.x cog.y	cog.x cog.y	cog.x cog.y cog.z
Parameter PayLoad - ix, iy, iz in loaddata in kgm2	iz	iz	ix iy iz	ix iy iz

The calculated data will be displayed on the FlexPendant.

Limitations

It is not possible to restart the load identification movements after any type of stop such as program stop, emergency stop or power failure. The load identification movements must be restarted from the beginning again.

Error handling

At any error during execution of the RAPID NOSTEPIN routine *ManLoadIdProc*, the

system variable ERRNO is set to ERR_PID_MOVESTOP, ERR_PID_RAISE_PP or ERR_LOADID_FATAL and the program pointer is raised to the user call of *ManLoadIdProc*.

Syntax

ManLoadIdProc
['\'ParIdType ':=' <expression (IN) of *paridnum*>]
['\'MechUnit ':=' <variable (VAR) of *mecunit*>]
| ['\'MechUnitName':=' <expression (IN) of *string*>]
['\' AxisNumber ':=' <expression (IN) of *num*>]
['\' PayLoad ':=' <var or pers (INOUT) of *loaddata]*>
['\' ConfigAngle<expression (IN) of *num*>]
['\' DeactAll] | ['\'AlreadyActive]
['\' DefinedFlag':=' <variable (VAR) of *bool*>] ';'

MechUnitLoad - Defines a payload for a mechanical unit

MechUnitLoad is used to define a payload for an external mechanical unit.
(The payload for the robot is defined with instruction *GripLoad*)

This instruction should be used for all mechanical units with dynamic model in servo to achieve the best motion performance.

The *MechUnitLoad* instruction should always be executed after execution of the instruction *ActUnit*.

This instruction can only be used in the *Main* task or, if in a MultiMove System, in Motion tasks.

Example

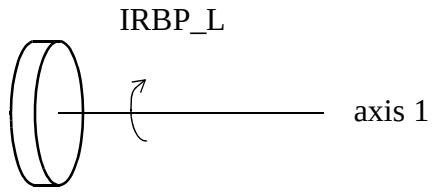


Figure 11 A mechanical unit named IRBP_L of type IRBP L.

```
ActUnit IRBP_L;
MechUnitLoad IRBP_L, 1, load0;
```

Activate mechanical unit *IRBP_L* and define the payload *load0* corresponding to no load (at all) mounted on axis *1*.

```
ActUnit IRBP_L;
MechUnitLoad IRBP_L, 1, fixture1;
```

Activate mechanical unit *IRBP_L* and define the payload *fixture1* corresponding to fixture *fixture1* mounted on axis *1*.

```
ActUnit IRBP_L;
MechUnitLoad IRBP_L, 1, workpiece1;
```

Activate mechanical unit *IRBP_L* and define the payload *workpiece1* corresponding to fixture and work piece named *workpiece1* mounted on axis *1*.

Arguments

MechUnitLoad **MechUnit AxisNo Load**

MechUnit *(Mechanical Unit)* Data type: *mecunit*

The name of the mechanical unit.

AxisNo *(Axis Number)* Data type: *num*

The axis number, within the mechanical unit, that holds the load.

Load Data type: *loaddata*

The load data that describes the current payload to be defined.

Program execution

After execution of *MechUnitLoad*, when the robot and external axes have come to a standstill, the specified load is defined for the specified mechanical unit and axis. This means that the payload is controlled and monitored by the control system.

The default payload at cold start-up, for a certain mechanical unit type, is the pre-defined maximal payload for this mechanical unit type.

When some other payload is used, the actual payload for the mechanical unit and axis should be redefined with this instruction. This should always be done after activation of the mechanical unit.

The defined payload will survive a power failure restart.
The defined payload will also survive a restart of the program after manual activation of some other mechanical units from the jogging window.

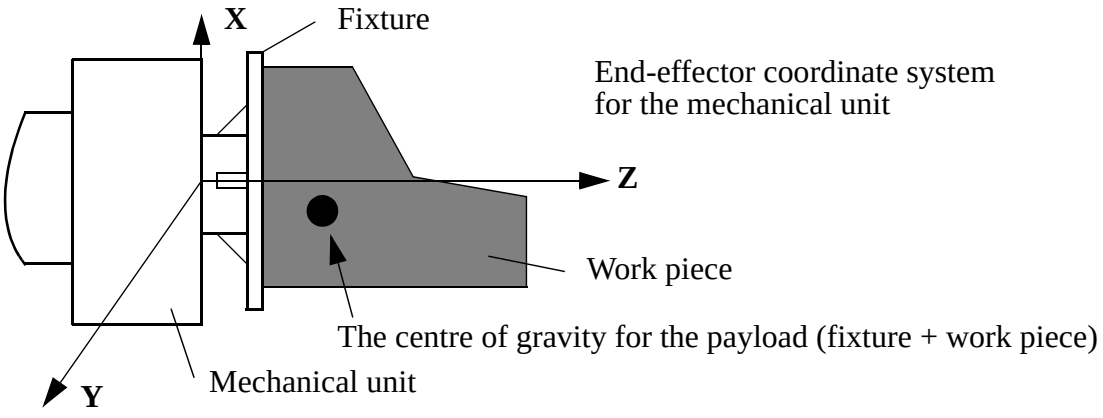


Figure 12 Payload mounted on the end-effector of a mechanical unit.

Example

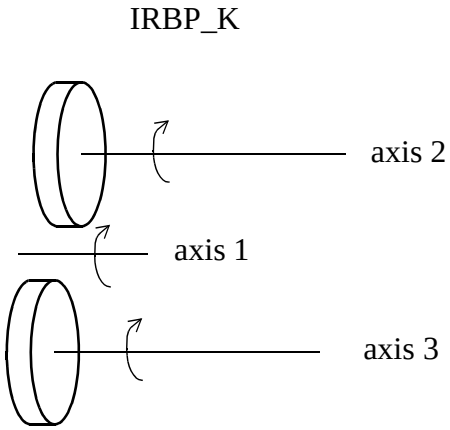


Figure 13 A mechanical unit named IRBP_K of type IRBP K with three axes.

```
MoveL homeside1, v1000, fine, gun1;
...
ActUnit IRBP_K;
```

The whole mechanical unit *IRBP_K* is activated.

```
MechUnitLoad IRBP_K, 2, workpiece1;
```

Defines payload *workpiece1* on the mechanical unit *IRBP_K* axis *2*.

```
MechUnitLoad IRBP_K, 3, workpiece2;
```

Defines payload *workpiece2* on the mechanical unit *IRBP_K* axis *3*.

```
MoveL homeside2, v1000, fine, gun1
```

The axes of the mechanical unit *IRBP_K* move to the switch position *homeside2* with mounted payload on both axes *2* and *3*.

Syntax

MechUnitLoad
[MechUnit ':='] < variable (VAR) of *mecunit*> **',' **
[AxisNo ':='] <expression (IN) of *num* **',' **
[Load ':='] < **persistent** (**PERS**) **of** *loaddata* > ';'

Related information

	Described in:
Identification of payload for external	LoadID&CollDetect mechanical units- Program muloadid.prg
Mechanical units	Data Types - mecunit
Definition of load data	Data Types - loaddata
Definition of payload for the robot	Instruction - GripLoad

MotionSup - Deactivates/Activates motion supervision

MotionSup (Motion Supervision) is used to deactivate or activate the motion supervision function for robot movements during program execution.

This instruction can only be used in the *Main* task or, if in a MultiMove System, in Motion tasks.

Description

Motion supervision is the name of a collection of functions for high sensitivity, model-based supervision of the robot. Currently it contains functionality for load supervision, jam supervision and collision detection. Because the supervision is designed to be very sensitive, it may trip if there are large process forces acting on the robot.

If the load is not correctly defined, use the load identification function to specify it. If large external process forces are present in most parts of the application, such as during deburring, then use the system parameters to raise the supervision level of the motion supervision until it no longer triggers. If, however, the external forces are only temporary, such as during the closing of a large spotweld gun, then the *MotionSup* instruction should be used to raise the supervision level (or turn the function off) for those parts of the application where the disturbance acts.

Examples

```
! If the motion supervision is active in the system parameters,
! then it is active by default during program execution
...
! If the motion supervision is deactivated through the system parameters,
! then it cannot be activated through the MotionSup instruction
...
! Deactivate motion supervision during program execution
MotionSup \Off;
...
! Activate motion supervision again during program execution
MotionSup \On;
...
! Tune the supervision level to 200% (makes the function less sensitive) of the level in
! the system parameters
MotionSup \On \TuneValue:= 200;
...
```

Arguments

MotionSup **[\On] | [\Off] [\TuneValue]**

[\On] Data type: *switch*

Activate the motion supervision function during program execution (if it has already been activated in system parameters).

[\Off] Data type: *switch*

Deactivate the motion supervision function during program execution.

One of the arguments *\On* or *\Off* must be specified.

[\TuneValue] Data type: *num*

Tuning the motion supervision sensitivity level in percent (1 - 300%) of system parameter level. A higher level gives more robust sensitivity. This argument can only be combined with argument *\On*.

Program execution

If the function motion supervision is active both in the system parameters and in the RAPID program and the motion supervision is triggered because of a collision etc., then

- the robot will stop as quickly as possible
- the robot will back up to remove any residual forces
- the program execution will stop with an error message

If motion supervision is active in system parameters, it is by default active during program execution (*TuneValue* 100%). These values are set automatically

- at a cold start-up
- when a new program is loaded
- when starting program execution from the beginning.

Limitations

Motion supervision is never active for external axes or when one or more joints are run in independent joint mode. When using the robot in the soft servo mode, it may be necessary to turn the motion supervision off to avoid accidental tripping.

Syntax

MotionSup
[’\’ On] | [’\’ Off]
[’\’ Tunevalue ’**:=’< expression (IN) of num>]** ’;’

Related information

	Described in:
General description of the function	Motion Principles - Motion Supervision
Tuning using system parameters	System Parameters

MoveAbsJ - Moves the robot to an absolute joint position

MoveAbsJ (*Move Absolute Joint*) is used to move the robot to an absolute position, defined in axes positions.

Example of use:

- the end point is a singular point
- for ambiguous positions on the IRB 6400C, e.g. for movements with the tool over the robot.

The final position of the robot, during a movement with MoveAbsJ, is neither affected by the given tool and work object, nor by active program displacement. However, the robot uses these data to calculating the load, TCP velocity, and the corner path. The same tools can be used as in adjacent movement instructions.

The robot and external axes move to the destination position along a non-linear path. All axes reach the destination position at the same time.

This instruction can only be used in the *Main* task or, if in a MultiMove System, in Motion tasks.

Examples

MoveAbsJ p50, v1000, z50, tool2;

The robot with the tool *tool2* is moved along a non-linear path to the absolute axis position, *p50*, with velocity data *v1000* and zone data *z50*.

MoveAbsJ *, v1000\T:=5, fine, grip3;

The robot with the tool *grip3*, is moved along a non-linear path to a stop point which is stored as an absolute axis position in the instruction (marked with an *). The entire movement takes 5 s.

Arguments

MoveAbsJ [\V] | [\T] [\Conc] ToJointPos [\ID] [\NoEOffs] Speed Zone [\Z] [\Inpos] Tool [\WObj]

[\Conc] *(Concurrent)* Data type: *switch*

Subsequent instructions are executed while the robot is moving. The argument is used to shorten the cycle time when, for example, communicating with external equipment, if synchronisation is not required.

Using the argument \Conc, the number of movement instructions in succession is limited to 5. In a program section that includes StorePath-RestoPath, movement instructions with the argument \Conc are not permitted.

If this argument is omitted and the ToPoint is not a stop point, the subsequent instruction is executed some time before the robot has reached the programmed zone.

This argument can not be used in coordinated synchronized movement in a MultiMove System.

ToJointPos (*To Joint Position*) Data type: *jointtarget*

The destination absolute joint position of the robot and external axes. It is defined as a named position or stored directly in the instruction (marked with an * in the instruction).

[\ID] *(Synchronization id)* Data type: *identno*

This argument must be used in a MultiMove System, if coordinated synchronized movement, and is not allowed in any other cases.

The specified id number must be the same in all cooperating program tasks. The id number gives a guarantee that the movements are not mixed up at runtime.

[\NoEOffs] (*No External Offsets)* Data type: *switch*

If the argument *NoEOffs* is set, then the movement with *MoveAbsJ* is not affected by active offsets for external axes.

Speed Data type: *speeddata*

The speed data that applies to movements. Speed data defines the velocity of the tool centre point, the tool reorientation and external axes.

[\V] *(Velocity)* Data type: *num*

This argument is used to specify the velocity of the TCP in mm/s directly in the instruction. It is then substituted for the corresponding velocity specified in the speed data.

[\T] *(Time)* Data type: *num*

This argument is used to specify the total time in seconds during which the robot moves. It is then substituted for the corresponding speed data.

Zone Data type: *zonedata*

Zone data for the movement. Zone data describes the size of the generated corner path.

[\Z] *(Zone)* Data type: *num*

This argument is used to specify the position accuracy of the robot TCP directly in the instruction. The length of the corner path is given in mm, which is substituted for the corresponding zone specified in the zone data.

[\Inpos] *(In position)* Data type: *stoppointdata*

This argument is used to specify the convergence criteria for the position of the robots TCP in the stop point. The stop point data substitutes the zone specified in the *Zone* parameter.

Tool Data type: *tooldata*

The tool in use during the movement.

The position of the TCP and the load on the tool are defined in the tool data. The TCP position is used to decide the velocity and the corner path for the movement.

[\WObj] *(Work Object)* Data type: *wobjdata*

The work object used during the movement.

This argument can be omitted if the tool is held by the robot. However, if the robot holds the work object, i.e. the tool is stationary, or with coordinated external axes, then the argument must be specified.

In the case of a stationary tool or coordinated external axes, the data used by the system to decide the velocity and the corner path for the movement, is defined in the work object.

Program execution

A movement with *MoveAbsJ* is not affected by active program displacement and if executed with switch *\NoEOffs, there will be* no offset for external axes.
Without switch *\NoEOffs*, the external axes in the destination target are affected by active offset for external axes.

The tool is moved to the destination absolute joint position with interpolation of the axis angles. This means that each axis is moved with constant axis velocity and that all axes reach the destination joint position at the same time, which results in a non-linear path.

Generally speaking, the TCP is moved at approximate programmed velocity. The tool is reoriented and the external axes are moved at the same time as the TCP moves. If the programmed velocity for reorientation, or for the external axes, cannot be attained, the velocity of the TCP will be reduced.

A corner path is usually generated when movement is transferred to the next section of the path. If a stop point is specified in the zone data, program execution only continues when the robot and external axes have reached the appropriate joint position.

Examples

MoveAbsJ *, v2000\V:=2200, z40 \Z:=45, grip3;

The tool, *grip3*, is moved along a non-linear path to an absolute joint position stored in the instruction. The movement is carried out with data set to *v2000* and *z40*. The velocity and zone size of the TCP are *2200* mm/s and *45* mm respectively.

MoveAbsJ p5, v2000, fine \Inpos := inpos50, grip3;

The tool, *grip3*, is moved along a non-linear path to an absolute joint position *p5*. The robot considers it to be in the point when 50% of the position condition and 50% of the speed condition for a stop point *fine* are satisfied. It waits at most for 2 seconds for the conditions to be satisfied. See predefined data *inpos50* of data type *stoppointdata*.

MoveAbsJ \Conc, *, v2000, z40, grip3;

The tool, *grip3*, is moved along a non-linear path to an absolute joint position stored in the instruction. Subsequent logical instructions are executed while the robot moves.

MoveAbsJ \Conc, * \NoEOffs, v2000, z40, grip3;

Same movement as above but the movement is not affected by active offsets for external axes.

```
GripLoad obj_mass;
MoveAbsJ start, v2000, z40, grip3 \WObj:= obj;
```

The robot moves the work object *obj* in relation to the fixed tool *grip3* along a non-linear path to an absolute axis position *start*.

Error handling

When running the program, a check is made that the arguments Tool and \WObj do not contain contradictory data with regard to a movable or a stationary tool respectively.

Limitations

In order to be able to run backwards with the instruction *MoveAbsJ* involved, and avoiding problems with singular points or ambiguous areas, it is essential that the subsequent instructions fulfil certain requirements, as follows (see Figure 1).

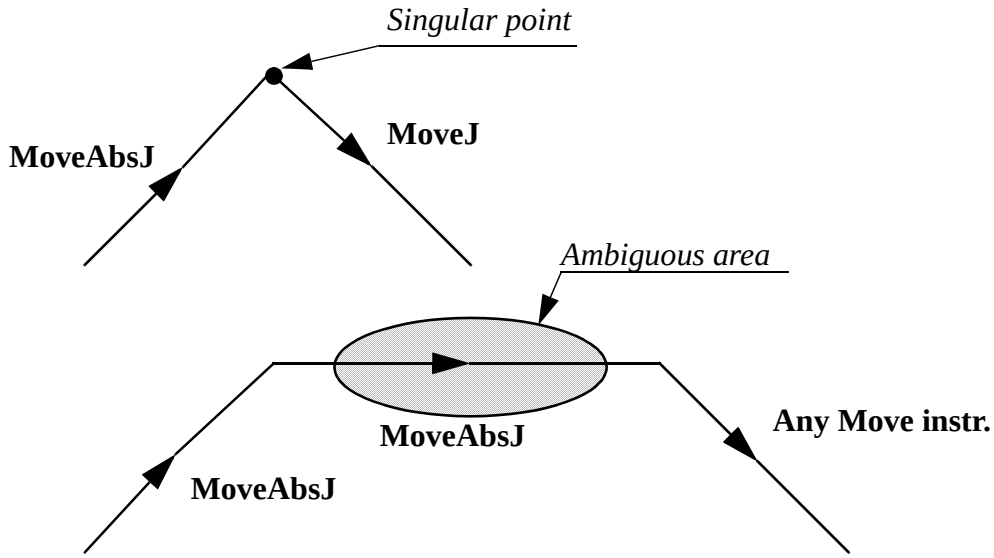


Figure 14 Limitation for backward execution with MoveAbsJ.

Syntax

MoveAbsJ
['\' Conc ',']
[ToJointPos ':='] < expression (**IN**) of *jointtarget* >
['\' ID ':=' < expression (**IN**) of *identno* >]','
['\' NoEoffs] ','
[Speed ':='] < expression (**IN**) of *speeddata* >
['\' V ':=' < expression (**IN**) of *num* >]
| ['\' T ':=' < expression (**IN**) of *num* >] ','
[Zone ':='] < expression (**IN**) of *zonedata* >
['\' Z ':=' < expression (**IN**) of *num* >]
['\' Inpos ':=' < expression (**IN**) of *stoppointdata* >] ','
[Tool ':='] < persistent (**PERS**) of *tooldata* >
['\' WObj ':=' < persistent (**PERS**) of *wobjdata* >] ';'

Related information

	Described in:
Other positioning instructions	RAPID Summary - Motion
Definition of jointtarget	Data Types - jointtarget
Definition of velocity	Data Types - speeddata
Definition of zone data	Data Types - zonedata
Definition of stop point data	Data Types - stoppointdata
Definition of tools	Data Types - tooldata
Definition of work objects	Data Types - wobjdata
Motion in general	Motion and I/O Principles
Concurrent program execution	Motion and I/O Principles - Synchronisation Using Logical Instructions

MoveC - Moves the robot circularly

MoveC is used to move the tool centre point (TCP) circularly to a given destination. During the movement, the orientation normally remains unchanged relative to the circle.

This instruction can only be used in the *Main* task or, if in a MultiMove System, in Motion tasks.

Examples

MoveC p1, p2, v500, z30, tool2;

The TCP of the tool, *tool*2, is moved circularly to the position *p2*, with speed data *v500* and zone data *z30*. The circle is defined from the start position, the circle point *p1* and the destination point *p2*.

MoveC *, *, v500 \T:=5, fine, grip3;

The TCP of the tool, *grip3*, is moved circularly to a fine point stored in the instruction (marked by the second *). The circle point is also stored in the instruction (marked by the first *). The complete movement takes *5* seconds.

MoveL p1, v500, fine, tool1;
MoveC p2, p3, v500, z20, tool1;
MoveC p4, p1, v500, fine, tool1;

A complete circle is performed if the positions are the same as those shown in Figure 15.

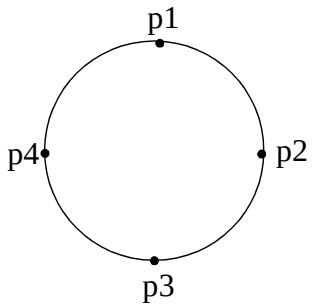


Figure 15 A complete circle is performed by two MoveC instructions.

Arguments

MoveC [\Conc] CirPoint ToPoint [\ID] Speed [\V] | [\T] Zone [\Z] [\Inpos] Tool [\WObj] [\Corr]

[\Conc] *(Concurrent)* Data type: *switch*

Subsequent instructions are executed while the robot is moving. The argument can be used to avoid unwanted stops, caused by overloaded CPU, when using fly-by points, and in this way shorten cycle time.This is useful when the programmed points are very close together at high speeds.The argument is also useful when, for example, communicating with external equipment and synchronisation between the external equipment and robot movement is not required.

Using the argument \Conc, the number of movement instructions in succession is limited to 5. In a program section that includes StorePath-RestoPath, movement instructions with the argument \Conc are not permitted.

If this argument is omitted, and the ToPoint is not a Stop point the subsequent instruction is executed some time before the robot has reached the programmed zone.

This argument can not be used in coordinated synchronized movement in a MultiMove System.

CirPoint Data type: *robtarget*

The circle point of the robot. The circle point is a position on the circle between the start point and the destination point. To obtain the best accuracy, it should be placed about halfway between the start and destination points. If it is placed too close to the start or destination point, the robot may give a warning. The circle point is defined as a named position or stored directly in the instruction (marked with an * in the instruction). The position of the external axes are not used.

ToPoint Data type: *robtarget*

The destination point of the robot and external axes. It is defined as a named position or stored directly in the instruction (marked with an * in the instruction).

[\ID] *(Synchronization id)* Data type: *identno*

This argument must be used in a MultiMove System, if coordinated synchronized movement, and is not allowed in any other cases.

The specified id number must be the same in all cooperating program tasks. The id number gives a guarantee that the movements are not mixed up at runtime.

Speed Data type: *speeddata*

The speed data that applies to movements. Speed data defines the velocity of the TCP, the tool reorientation and external axes.

[\V] *(Velocity)* Data type: *num*

This argument is used to specify the velocity of the TCP in mm/s directly in the instruction. It is then substituted for the corresponding velocity specified in the speed data.

[\T] *(Time)* Data type: *num*

This argument is used to specify the total time in seconds during which the robot and external axes move. It is then substituted for the corresponding speed data.

Zone Data type: *zonedata*

Zone data for the movement. Zone data describes the size of the generated corner path.

[\Z] *(Zone)* Data type: *num*

This argument is used to specify the position accuracy of the robot TCP directly in the instruction. The length of the corner path is given in mm, which is substituted for the corresponding zone specified in the zone data.

[\Inpos] *(In position)* Data type: *stoppointdata*

This argument is used to specify the convergence criteria for the position of the robot's TCP in the stop point. The stop point data substitutes the zone specified in the *Zone* parameter.

Tool Data type: *tooldata*

The tool in use when the robot moves. The tool centre point is the point that is moved to the specified destination point.

[\WObj] *(Work Object)* Data type: *wobjdata*

The work object (object coordinate system) to which the robot position in the instruction is related.

This argument can be omitted, and if it is, the position is related to the world coordinate system. If, on the other hand, a stationary TCP or coordinated external axes are used, this argument must be specified in order for a circle relative to the work object to be executed.

[\Corr] *(Correction)* Data type: *switch*

Correction data written to a corrections entry by the instruction *CorrWrite* will be added to the path and destination position, if this argument is present.

Program execution

The robot and external units are moved to the destination point as follows:

- The TCP of the tool is moved circularly at constant programmed velocity.
- The tool is reoriented at a constant velocity, from the orientation at the start position to the orientation at the destination point.
- The reorientation is performed relative to the circular path. Thus, if the orientation relative to the path is the same at the start and the destination points, the relative orientation remains unchanged during the movement (see Figure 16).

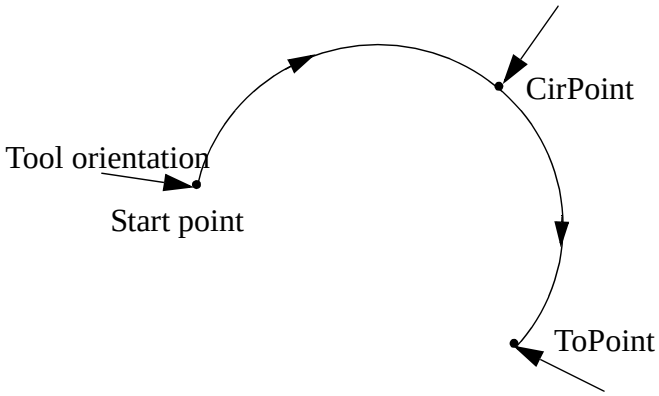


Figure 16 Tool orientation during circular movement.

The orientation at the circle point is not critical. It is only used to distinguish between two possible directions of reorientation. The accuracy of the reorientation along the path depends only on the orientation at the start and destination points.

- Uncoordinated external axes are executed at constant velocity in order for them to arrive at the destination point at the same time as the robot axes. The position in the circle position is not used.

If it is not possible to attain the programmed velocity for the reorientation or for the external axes, the velocity of the TCP will be reduced.

A corner path is usually generated when movement is transferred to the next section of a path. If a stop point is specified in the zone data, program execution only continues when the robot and external axes have reached the appropriate position.

Examples

MoveC *, *, v500 \V:=550, z40 \Z:=45, grip3;

The TCP of the tool, *grip3*, is moved circularly to a position stored in the instruction. The movement is carried out with data set to *v500* and *z40*; the velocity and zone size of the TCP are *550* mm/s and *45* mm respectively.

MoveC p5, p6, v2000, fine \Inpos := inpos50, grip3;

The TCP of the tool, *grip3,* is moved circularly to a stop point *p6*. The robot considers it to be in the point when 50% of the position condition and 50% of the speed condition for a stop point *fine* are satisfied. It waits at most for 2 seconds for the conditions to be satisfied. See predefined data *inpos50* of data type *stoppointdata.*

MoveC \Conc, *, *, v500, z40, grip3;

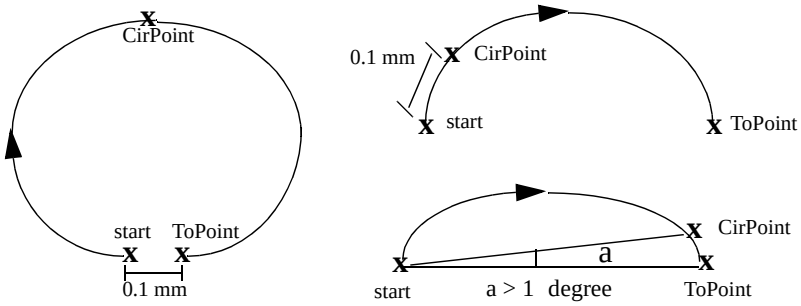
The TCP of the tool, *grip3,* is moved circularly to a position stored in the instruction. The circle point is also stored in the instruction. Subsequent logical instructions are executed while the robot moves.

MoveC cir1, p15, v500, z40, grip3 \WObj:=fixture;

The TCP of the tool, *grip3*, is moved circularly to a position, *p15*, via the circle point *cir1*. These positions are specified in the object coordinate system for *fixture*.

Limitations

There are some limitations in how the *CirPoint* and the *ToPoint* can be placed, as shown in the figure below.



- Minimum distance between start and *ToPoint* is 0.1 mm
- Minimum distance between start and *CirPoint* is 0.1 mm
- Minimum angle between *CirPoint* and *ToPoint* from the start point is 1 degree

The accuracy can be poor near the limits, e.g. if the start point and the *ToPoint* on the circle are close to each other, the fault caused by the leaning of the circle can be much greater than the accuracy with which the points have been programmed.

A change of execution mode from forward to backward or vice versa, while the robot is stopped on a circular path, is not permitted and will result in an error message.

The instruction *MoveC (*or any other instruction including circular movement) should never be started from the beginning, with TCP between the circle point and the end point. Otherwise the robot will not take the programmed path (positioning around the circular path in another direction compared with that programmed).

Make sure that the robot can reach the circle point during program execution and divide the circle segment if necessary.

Syntax

MoveC
[’\’ Conc ’,’]
[CirPoint ’:=’] < expression (**IN**) of *robtarget* > ’,’
[ToPoint ’:=’] < expression (**IN**) of *robtarget* > ’,’
[’\’ ID ’:=’ < expression (**IN**) of *identno* >]’,’
[Speed ’:=’] < expression (**IN**) of *speeddata* >
[’\’ V ’:=’ < expression (**IN**) of *num* >]
| [’\’ T ’:=’ < expression (**IN**) of *num* >] ’,’
[Zone ’:=’] < expression (**IN**) of *zonedata* >
[’\’ Z ’:=’ < expression (**IN**) of *num* >]
[’\’ Inpos ’:=’ < expression (**IN**) of *stoppointdata* >] ‘,’
[Tool ’:=’] < persistent (**PERS**) of *tooldata* >
[’\’ WObj ’:=’ < persistent (**PERS**) of *wobjdata* >]
[’\’ Corr]’;’

Related information

	Described in:
Other positioning instructions	RAPID Summary - Motion
Definition of velocity	Data Types - speeddata
Definition of zone data	Data Types - zonedata
Definition of stop point data	Data Types - stoppointdata
Definition of tools	Data Types - tooldata
Definition of work objects	Data Types - wobjdata
Writes to a corrections entry	Instructions - CorrWrite
Motion in general	Motion and I/O Principles
Coordinate systems	Motion and I/O Principles - Coordinate Systems
Concurrent program execution	Motion and I/O Principles - Synchronisation Using Logical Instructions

MoveCDO - Moves the robot circularly and sets digital output in the corner

MoveCDO (*Move Circular Digital Output*) is used to move the tool centre point (TCP) circularly to a given destination. The specified digital output is set/reset in the middle of the corner path at the destination point. During the movement, the orientation normally remains unchanged relative to the circle.

This instruction can only be used in the *Main* task or, if in a MultiMove System, in Motion tasks.

Examples

MoveCDO p1, p2, v500, z30, tool2, do1,1;

The TCP of the tool, *tool2*, is moved circularly to the position *p2*, with speed data *v500* and zone data *z30*. The circle is defined from the start position, the circle point *p1* and the destination point *p2*. Output *do1* is set in the middle of the corner path at *p2*.

Arguments

MoveCDO **CirPoint**
ToPoint [\ID] Speed [\T] Zone Tool
[\WObj] Signal
Value

CirPoint Data type: *robtarget*

The circle point of the robot. The circle point is a position on the circle between the start point and the destination point. To obtain the best accuracy, it should be placed about halfway between the start and destination points. If it is placed too close to the start or destination point, the robot may give a warning. The circle point is defined as a named position or stored directly in the instruction (marked with an * in the instruction). The position of the external axes are not used.

ToPoint Data type: *robtarget*

The destination point of the robot and external axes. It is defined as a named position or stored directly in the instruction (marked with an * in the instruction).

[\ID] *(Synchronization id)* Data type: *identno*

This argument must be used in a MultiMove System, if coordinated synchronized movement, and is not allowed in any other cases.

The specified id number must be the same in all cooperating program tasks. The

id number gives a guarantee that the movements are not mixed up at runtime.

Speed Data type: *speeddata*

The speed data that applies to movements. Speed data defines the velocity of the TCP, the tool reorientation and external axes.

[\T] *(Time)* Data type: *num*

This argument is used to specify the total time in seconds during which the robot and external axes move. It is then substituted for the corresponding speed data.

Zone Data type: *zonedata*

Zone data for the movement. Zone data describes the size of the generated corner path.

Tool Data type: *tooldata*

The tool in use when the robot moves. The tool centre point is the point that is moved to the specified destination point.

[\WObj] *(Work Object)* Data type: *wobjdata*

The work object (object coordinate system) to which the robot position in the instruction is related.

This argument can be omitted, and if it is, the position is related to the world coordinate system. If, on the other hand, a stationary TCP or coordinated external axes are used, this argument must be specified in order for a circle relative to the work object to be executed.

Signal Data type: *signaldo*

The name of the digital output signal to be changed.

Value Data type: *dionum*

The desired value of signal (0 or 1).

Program execution

See the instruction *MoveC* for more information about circular movement.

The digital output signal is set/reset in the middle of the corner path for flying points, as shown in Figure 17.

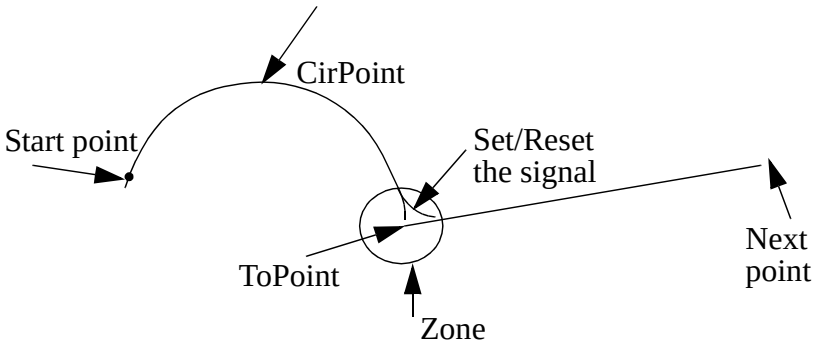


Figure 17 Set/Reset of digital output signal in the corner path with MoveCDO.

For stop points, we recommend the use of “normal” programming sequence with *MoveC + SetDO*. But when using stop point in instruction *MoveCDO*, the digital output signal is set/reset when the robot reaches the stop point.

The specified I/O signal is set/reset in execution mode continuously and stepwise forward but not in stepwise backward.

Limitations

General limitations according to instruction *MoveC*.

Syntax

MoveCDO
[CirPoint ’:=’] < expression (**IN**) of *robtarget* > ’,’
[ToPoint ’:=’] < expression (**IN**) of *robtarget* > ’,’
[’\’ ID ’:=’ < expression (**IN**) of *identno* >]’,’
[Speed ’:=’] < expression (**IN**) of *speeddata* >
[’\’ T ’:=’ < expression (**IN**) of *num* >] ’,’
[Zone ’:=’] < expression (**IN**) of *zonedata* > ’,’
[Tool ’:=’] < persistent (**PERS**) of *tooldata* >
[’\’ WObj ’:=’ < persistent (**PERS**) of *wobjdata* >] ’,’
[Signal ’:=’] < variable (**VAR**) of *signaldo*>] ‘,’
[Value ‘:=’] < expression (**IN**) of *dionum* >] ’;’

Related information

	Described in:
Other positioning instructions	RAPID Summary - Motion
Definition of velocity	Data Types - speeddata
Definition of zone data	Data Types - zonedata
Definition of tools	Data Types - tooldata
Definition of work objects	Data Types - wobjdata
Motion in general	Motion and I/O Principles
Coordinate systems	Motion and I/O Principles - Coordinate Systems
Movements with I/O settings	Motion and I/O Principles - Synchronisation Using Logical Instructions

MoveCSync - Moves the robot circularly and executes a RAPID procedure

MoveCSync (*Move Circular Synchronously*) is used to move the tool centre point (TCP) circularly to a given destination. The specified RAPID procedure is executed at the middle of the corner path in the destination point. During the movement, the orientation normally remains unchanged relative to the circle.

This instruction can only be used in the *Main* task or, if in a MultiMove System, in Motion tasks.

Examples

MoveCSync p1, p2, v500, z30, tool2, “proc1”;

The TCP of the tool, *tool2*, is moved circularly to the position *p2*, with speed data *v500* and zone data *z30*. The circle is defined from the start position, the circle point *p1* and the destination point *p2*. Procedure *proc1* is executed in the middle of the corner path at *p2*.

Arguments

MoveCSync [\WObj] CirPoint ToPoint [\ID] Speed [\T] Zone Tool ProcName

CirPoint Data type: *robtarget*

The circle point of the robot. The circle point is a position on the circle between the start point and the destination point. To obtain the best accuracy, it should be placed about halfway between the start and destination points. If it is placed too close to the start or destination point, the robot may give a warning. The circle point is defined as a named position or stored directly in the instruction (marked with an * in the instruction). The position of the external axes are not used.

ToPoint Data type: *robtarget*

The destination point of the robot and external axes. It is defined as a named position or stored directly in the instruction (marked with an * in the instruction).

[\ID] *(Synchronization id)* Data type: *identno*

This argument must be used in a MultiMove System, if coordinated synchronized movement, and is not allowed in any other cases.

The specified id number must be the same in all cooperating program tasks. The id number gives a guarantee that the movements are not mixed up at runtime.

Speed Data type: *speeddata*

The speed data that applies to movements. Speed data defines the velocity of the TCP, the tool reorientation and external axes.

[\T] *(Time)* Data type: *num*

This argument is used to specify the total time in seconds during which the robot and external axes move. It is then substituted for the corresponding speed data.

Zone Data type: *zonedata*

Zone data for the movement. Zone data describes the size of the generated corner path.

Tool Data type: *tooldata*

The tool in use when the robot moves. The tool centre point is the point that is moved to the specified destination point.

[\WObj] *(Work Object)* Data type: *wobjdata*

The work object (object coordinate system) to which the robot position in the instruction is related.

This argument can be omitted, and if it is, the position is related to the world coordinate system. If, on the other hand, a stationary TCP or coordinated external axes are used, this argument must be specified.

ProcName *(Procedure Name)* Data type: *string*

Name of the RAPID procedure to be executed at the middle of the corner path in the destination point.

Program execution

See the instruction *MoveC* for more information about circular movements.

The specified RAPID procedure is executed when the TCP reaches the middle of the corner path in the destination point of the *MoveCSync* instruction, as shown in Figure 18:

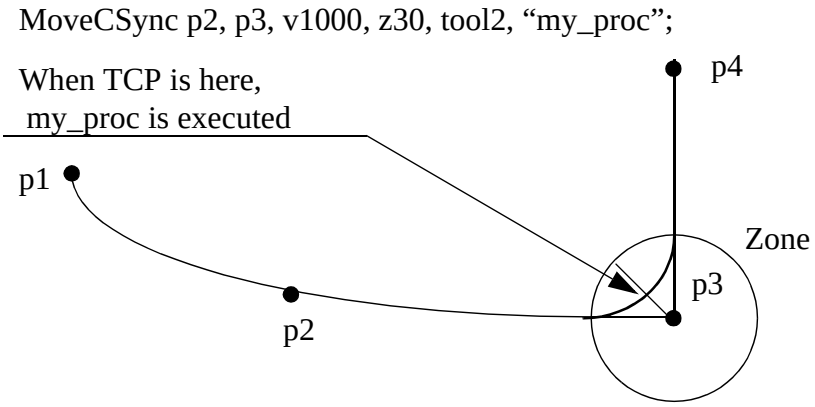


Figure 18 Execution of user-defined RAPID procedure at the middle of the corner path.

For stop points, we recommend the use of “normal” programming sequence with *MoveC* + other RAPID instructions in sequence.

Execution of the specified RAPID procedure in different execution modes:

Execution mode:	Execution of RAPID procedure:
Continuously or Cycle	According to this description
Forward step	In the stop point
Backward step	Not at all

Limitation

General limitations according to instruction *MoveC.*

Switching execution mode after program stop from continuously or cycle to stepwise forward or backward results in an error. This error tells the user that the mode switch can result in missed execution of a RAPID procedure in the queue for execution on the path. This error can be avoided if the program is stopped with StopInstr before the mode switch.

Instruction *MoveCSync* cannot be used on TRAP level.
The specified RAPID procedure cannot be tested with stepwise execution.

Syntax

MoveCSync
[CirPoint ':='] < expression (**IN**) of *robtarget* > ','
[ToPoint ':='] < expression (**IN**) of *robtarget* > ','
['\' ID ':=' < expression (**IN**) of *identno* >]','
[Speed ':='] < expression (**IN**) of *speeddata* >
['\' T ':=' < expression (**IN**) of *num* >] ','
[Zone ':='] < expression (**IN**) of *zonedata* > ','
[Tool ':='] < persistent (**PERS**) of *tooldata* >
['\' WObj ':=' < persistent (**PERS**) of *wobjdata* >] ','
[ProcName ':='] < expression (**IN**) of *string* >] ';'

Related information

	Described in:
Other positioning instructions	RAPID Summary - Motion
Definition of velocity	Data Types - speeddata
Definition of zone data	Data Types - zonedata
Definition of tools	Data Types - tooldata
Definition of work objects	Data Types - wobjdata
Motion in general	Motion and I/O Principles
Coordinate systems	Motion and I/O Principles - Coordinate Systems

MoveExtJ - Move one or several mechanical units without TCP

MoveExtJ (*Move External Joints*) is used to move only linear or rotating external axes. The external axes can belong to one or several mechanical units without TCP.

This instruction can only be used:

- with actual program task defined as a Motion Task and
- if the task controls one or several mechanical units without TCP and

Examples

MoveExtJ jpos10, vrot10, z50;

Move rotational external axes to joint position *jpos10* with speed *10* degrees/s with zone data *z50*.

MoveExtJ \Conc, jpos20, vrot10 \T:=5, fine \InPos:=inpos20;

Move external axes to joint position *jpos20* in 5 s.The program execution goes forward at once but the external axes stops in the position *jpos20* until the convergence criteria in *inpos20* are fulfilled.

Arguments

MoveExtj [\Conc] ToJointPos [\ID] Speed [\T] Zone [\Inpos]

[\Conc] *(Concurrent)* Data type: *switch*

Subsequent instructions are executed while the external axis is moving. The argument can be used to avoid unwanted stops, caused by overloaded CPU, when using fly-by points, and in this way shorten cycle time.This is useful when the programmed points are very close together at high speeds.The argument is also useful when, for example, communicating with external equipment and synchronisation between the external equipment and robot movement is not required.

Using the argument *\Conc*, the number of movement instructions in succession is limited to 5. In a program section that includes *StorePath-RestoPath*, movement instructions with the argument *\Conc* are not permitted.

If this argument is omitted and the *ToJointPos* is not a stop point, the subsequent instruction is executed some time before the external axes has reached the programmed zone.

This argument can not be used in coordinated synchronized movement in a MultiMove System.

ToJointPos (*To Joint Position*) Data type: *jointtarget*

The destination absolute joint position of the external axes. It is defined as a named position or stored directly in the instruction (marked with an * in the instruction).

[\ID] *(Synchronization ID)* Data type: *identno*

This argument must be used in a MultiMove System, if coordinated synchronized movement, and is not allowed in any other cases.

The specified id number must be the same in all cooperating program tasks. The id number gives a guarantee that the movements are not mixed up at runtime.

Speed Data type: *speeddata*

The speed data that applies to movements. Speed data defines the velocity of the linear or rotating external axis.

[\T] *(Time)* Data type: *num*

This argument is used to specify the total time in seconds during which the external axes move. It is then substituted for the corresponding speed data.

Zone Data type: *zonedata*

Zone data for the movement. Zone data describes if stop point or if fly-by point the zone size for the deceleration and accelerate of the linear or rotational external axes.

[\Inpos] *(In position)* Data type: *stoppointdata*

This argument is used to specify the convergence criteria for the position of the external axis in the stop point. The stop point data substitutes the zone specified in the *Zone* parameter.

Program execution

The linear or rotating external axes are moved to the programmed point with the programmed velocity.

Examples

```
CONST jointtarget j1 := [[9E9,9E9,9E9,9E9,9E9,9E9],[0,9E9,9E9,9E9,9E9,9E9]];
CONST jointtarget j2 := [[9E9,9E9,9E9,9E9,9E9,9E9],[30,9E9,9E9,9E9,9E9,9E9]];
CONST jointtarget j3 := [[9E9,9E9,9E9,9E9,9E9,9E9],[60,9E9,9E9,9E9,9E9,9E9]];
CONST jointtarget j4 := [[9E9,9E9,9E9,9E9,9E9,9E9],[90,9E9,9E9,9E9,9E9,9E9]];
CONST speeddata rot_ax_speed := [0, 0, 0, 45];

MoveExtJ j1, rot_ax_speed, fine;
MoveExtJ j2, rot_ax_speed, z20;
MoveExtJ j3, rot_ax_speed, z20;
MoveExtJ j4, rot_ax_speed, fine;
```

In this example the rotating single axis is moved to joint position *0*, *30*, *60* and *90* degrees with the speed of *45* degrees/s.

Syntax

```
MoveExtJ
   [ '\' Conc ',' ]
   [ ToJointPos ':=' ] < expression (IN) of jointtarget >
     [ '\' ID ':=' < expression (IN) of identno >]',’
   [ Speed ':=' ] < expression (IN) of speeddata >
     [ '\' T ':=' < expression (IN) of num > ] ',’
   [Zone ':=' ] < expression (IN) of zonedata >
     [ '\' Inpos ':=' < expression (IN) of stoppointdata >]';’
```

Related information

	Described in:
Other positioning instructions	RAPID Summary - Motion
Definition of jointtarget	Data Types - jointtarget
Definition of velocity	Data Types - speeddata
Definition of zone data	Data Types - zonedata
Motion in general	Motion and I/O PrinciplesConcurrent program execution. Motion and I/O Principles - Synchronisation Using Logical Instructions

MoveJ - Moves the robot by joint movement

MoveJ is used to move the robot quickly from one point to another when that movement does not have to be in a straight line.

The robot and external axes move to the destination position along a non-linear path. All axes reach the destination position at the same time.

This instruction can only be used in the *Main* task or, if in a MultiMove System, in Motion tasks.

Examples

MoveJ p1, vmax, z30, tool2;

The tool centre point (TCP) of the tool, *tool*2, is moved along a non-linear path to the position, *p1*, with speed data *vmax* and zone data *z30*.

MoveJ *, vmax \T:=5, fine, grip3;

The TCP of the tool, *grip3*, is moved along a non-linear path to a stop point stored in the instruction (marked with an *). The entire movement takes *5* seconds.

Arguments

MoveJ [\Conc] ToPoint [\ID] Speed [\V] | [\T] Zone [\Z] [\Inpos] Tool [\WObj]

[\Conc] *(Concurrent)* Data type: *switch*

Subsequent instructions are executed while the robot is moving. The argument can be used to avoid unwanted stops, caused by overloaded CPU, when using fly-by points, and in this way shorten cycle time.This is useful when the programmed points are very close together at high speeds.The argument is also useful when, for example, communicating with external equipment and synchronisation between the external equipment and robot movement is not required.

Using the argument \Conc, the number of movement instructions in succession is limited to 5. In a program section that includes StorePath-RestoPath, movement instructions with the argument \Conc are not permitted.

If this argument is omitted and the ToPoint is not a stop point, the subsequent instruction is executed some time before the robot has reached the programmed zone.

This argument can not be used in coordinated synchronized movement in a MultiMove System.

ToPoint Data type: *robtarget*

The destination point of the robot and external axes. It is defined as a named position or stored directly in the instruction (marked with an * in the instruction).

[\ID *(Synchronization id)* Data type: *identno*

This argument must be used in a MultiMove System, if coordinated synchronized movement, and is not allowed in any other cases.

The specified id number must be the same in all cooperating program tasks. The id number gives a guarantee that the movements are not mixed up at runtime.

Speed Data type: *speeddata*

The speed data that applies to movements. Speed data defines the velocity of the tool centre point, the tool reorientation and external axes.

[\V] *(Velocity)* Data type: *num*

This argument is used to specify the velocity of the TCP in mm/s directly in the instruction. It is then substituted for the corresponding velocity specified in the speed data.

[\T] *(Time)* Data type: *num*

This argument is used to specify the total time in seconds during which the robot moves. It is then substituted for the corresponding speed data.

Zone Data type: *zonedata*

Zone data for the movement. Zone data describes the size of the generated corner path.

[\Z] *(Zone)* Data type: *num*

This argument is used to specify the position accuracy of the robot TCP directly in the instruction. The length of the corner path is given in mm, which is substituted for the corresponding zone specified in the zone data.

[\Inpos] *(In position)* Data type: *stoppointdata*

This argument is used to specify the convergence criteria for the position of the robot's TCP in the stop point. The stop point data substitutes the zone specified in the *Zone* parameter.

Tool Data type: *tooldata*

The tool in use when the robot moves. The tool centre point is the point moved to the specified destination point.

[\WObj] *(Work Object)* Data type: *wobjdata*

The work object (coordinate system) to which the robot position in the instruction is related.

This argument can be omitted, and if it is, the position is related to the world coordinate system. If, on the other hand, a stationary TCP or coordinated external axes are used, this argument must be specified.

Program execution

The tool centre point is moved to the destination point with interpolation of the axis angles. This means that each axis is moved with constant axis velocity and that all axes reach the destination point at the same time, which results in a non-linear path.

Generally speaking, the TCP is moved at the approximate programmed velocity (regardless of whether or not the external axes are coordinated). The tool is reoriented and the external axes are moved at the same time as the TCP moves. If the programmed velocity for reorientation, or for the external axes, cannot be attained, the velocity of the TCP will be reduced.

A corner path is usually generated when movement is transferred to the next section of the path. If a stop point is specified in the zone data, program execution only continues when the robot and external axes have reached the appropriate position.

Examples

MoveJ *, v2000\V:=2200, z40 \Z:=45, grip3;

The TCP of the tool, *grip3*, is moved along a non-linear path to a position stored in the instruction. The movement is carried out with data set to *v2000* and *z40*; the velocity and zone size of the TCP are *2200* mm/s and *45* mm respectively.

MoveJ p5, v2000, fine \Inpos := inpos50, grip3;

The TCP of the tool, *grip3*, is moved a non-linear path to a stop point *p5*. The robot considers it to be in the point when 50% of the position condition and 50% of the speed condition for a stop point *fine* are satisfied. It waits at most for 2 seconds for the conditions to be satisfied. See predefined data *inpos50* of data type *stoppointdata*.

MoveJ \Conc, *, v2000, z40, grip3;

The TCP of the tool, *grip3*, is moved along a non-linear path to a position stored in the instruction. Subsequent logical instructions are executed while the robot moves.

MoveJ start, v2000, z40, grip3 \WObj:=fixture;

The TCP of the tool, *grip3*, is moved along a non-linear path to a position, *start*. This position is specified in the object coordinate system for *fixture*.

Syntax

MoveJ
[’\’ Conc ’,’]
[ToPoint ’:=’] < expression (**IN**) of *robtarget* > ’,’
[’\’ ID ’:=’ < expression (**IN**) of *identno* >]’,’
[Speed ’:=’] < expression (**IN**) of *speeddata* >
[’\’ V ’:=’ < expression (**IN**) of *num* >]
| [’\’ T ’:=’ < expression (**IN**) of *num* >] ’,’
[Zone ’:=’] < expression (**IN**) of *zonedata* >
[’\’ Z ‘:=’ < expression (**IN**) of *num* >]
[’\’ Inpos ’:=’ < expression (**IN**) of *stoppointdata* >] ‘,’
[Tool ’:=’] < persistent (**PERS**) of *tooldata* >
[’\’ WObj ’:=’ < persistent (**PERS**) of *wobjdata* >] ’;’

Related information

	Described in:
Other positioning instructions	RAPID Summary - Motion
Definition of velocity	Data Types - speeddata
Definition of zone data	Data Types - zonedata
Definition of stop point data	Data Types - stoppointdata
Definition of tools	Data Types - tooldata
Definition of work objects	Data Types - wobjdata
Motion in general	Motion and I/O Principles
Coordinate systems	Motion and I/O Principles - Coordinate Systems
Concurrent program execution	Motion and I/O Principles - Synchronisation Using Logical Instructions

MoveJDO - Moves the robot by joint movement and sets digital output in the corner

MoveJDO (*Move Joint Digital Output*) is used to move the robot quickly from one point to another when that movement does not have to be in a straight line. The specified digital output signal is set/reset at the middle of the corner path.

The robot and external axes move to the destination position along a non-linear path. All axes reach the destination position at the same time.

This instruction can only be used in the *Main* task or, if in a MultiMove System, in Motion tasks.

Examples

MoveJDO p1, vmax, z30, tool2, do1, 1;

The tool centre point (TCP) of the tool, *tool2*, is moved along a non-linear path to the position, *p1*, with speed data *vmax* and zone data *z30*. Output *do1* is set in the middle of the corner path at *p1*.

Arguments

MoveJDO ToPoint [\ID] Speed [\T] Zone Tool [\WObj] Signal Value

ToPoint Data type: *robtarget*

The destination point of the robot and external axes. It is defined as a named position or stored directly in the instruction (marked with an * in the instruction).

[\ID] *(Synchronization id)* Data type: *identno*

This argument must be used in a MultiMove System, if coordinated synchronized movement, and is not allowed in any other cases.

The specified id number must be the same in all cooperating program tasks. The id number gives a guarantee that the movements are not mixed up at runtime.

Speed Data type: *speeddata*

The speed data that applies to movements. Speed data defines the velocity of the tool centre point, the tool reorientation and external axes.

[\T] *(Time)* Data type: *num*

This argument is used to specify the total time in seconds during which the robot moves. It is then substituted for the corresponding speed data.

Zone Data type: *zonedata*

Zone data for the movement. Zone data describes the size of the generated corner path.

Tool Data type: *tooldata*

The tool in use when the robot moves. The tool centre point is the point moved to the specified destination point.

[\WObj] *(Work Object)* Data type: *wobjdata*

The work object (coordinate system) to which the robot position in the instruction is related.

This argument can be omitted, and if it is, the position is related to the world coordinate system. If, on the other hand, a stationary TCP or coordinated external axes are used, this argument must be specified.

Signal Data type: *signaldo*

The name of the digital output signal to be changed.

Value Data type: *dionum*

The desired value of signal (0 or 1).

Program execution

See the instruction *MoveJ* for more information about joint movement.

The digital output signal is set/reset in the middle of the corner path for flying points, as shown in Figure 19.

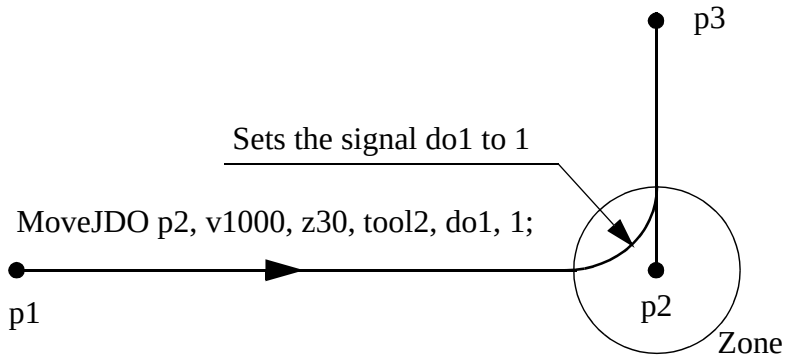


Figure 19 Set/Reset of digital output signal in the corner path with MoveJDO.

For stop points, we recommend the use of “normal” programming sequence with

MoveJ + SetDO. But when using stop point in instruction *MoveJDO*, the digital output signal is set/reset when the robot reaches the stop point.

The specified I/O signal is set/reset in execution mode continuously and stepwise forward but not in stepwise backward.

Syntax

MoveJDO
[ToPoint ':='] < expression (**IN**) of *robtarget* > ','
['\' ID ':=' < expression (**IN**) of *identno* >]','
[Speed ':='] < expression (**IN**) of *speeddata* >
['\' T ':=' < expression (**IN**) of *num* >] ','
[Zone ':='] < expression (**IN**) of *zonedata* > ','
[Tool ':='] < persistent (**PERS**) of *tooldata* >
['\' WObj ':=' < persistent (**PERS**) of *wobjdata* >] ','
[Signal ':='] < variable (**VAR**) of *signaldo*>] ','
[Value ':='] < expression (**IN**) of *dionum* >] ';'

Related information

	Described in:
Other positioning instructions	RAPID Summary - Motion
Definition of velocity	Data Types - speeddata
Definition of zone data	Data Types - zonedata
Definition of tools	Data Types - tooldata
Definition of work objects	Data Types - wobjdata
Motion in general	Motion and I/O Principles
Coordinate systems	Motion and I/O Principles - Coordinate Systems
Movements with I/O settings	Motion and I/O Principles - Synchronisation Using Logical Instructions

MoveJSync - Moves the robot by joint movement and executes a RAPID procedure

MoveJSync (*Move Joint Synchronously)* is used to move the robot quickly from one point to another when that movement does not have to be in a straight line. The specified RAPID procedure is executed at the middle of the corner path in the destination point.

The robot and external axes move to the destination position along a non-linear path. All axes reach the destination position at the same time.

This instruction can only be used in the *Main* task or, if in a MultiMove System, in Motion tasks.

Examples

MoveJSync p1, vmax, z30, tool2, “proc1”;

The tool centre point (TCP) of the tool, *tool2*, is moved along a non-linear path to the position, *p1*, with speed data *vmax* and zone data *z30*. Procedure *proc1* is executed in the middle of the corner path at *p1*.

Arguments

MoveJSync ToPoint [\ID] Speed [\T] Zone Tool [\WObj] ProcName

ToPoint Data type: *robtarget*

The destination point of the robot and external axes. It is defined as a named position or stored directly in the instruction (marked with an * in the instruction).

[\ID] *(Synchronization id)* Data type: *identno*

This argument must be used in a MultiMove System, if coordinated synchronized movement, and is not allowed in any other cases.

The specified id number must be the same in all cooperating program tasks. The id number gives a guarantee that the movements are not mixed up at runtime.

Speed Data type: *speeddata*

The speed data that applies to movements. Speed data defines the velocity of the tool centre point, the tool reorientation and external axes.

[\T] *(Time)* Data type: *num*

This argument is used to specify the total time in seconds during which the robot

moves. It is then substituted for the corresponding speed data.

Zone Data type: *zonedata*

Zone data for the movement. Zone data describes the size of the generated corner path.

Tool Data type: *tooldata*

The tool in use when the robot moves. The tool centre point is the point moved to the specified destination point.

[\WObj] *(Work Object)* Data type: *wobjdata*

The work object (coordinate system) to which the robot position in the instruction is related.

This argument can be omitted, and if it is, the position is related to the world coordinate system. If, on the other hand, a stationary TCP or coordinated external axes are used, this argument must be specified.

ProcName *(Procedure Name)* Data type: *string*

Name of the RAPID procedure to be executed at the middle of the corner path in the destination point.

Program execution

See the instruction *MoveJ* for more information about joint movements.

The specified RAPID procedure is executed when the TCP reaches the middle of the corner path in the destination point of the *MoveJSync* instruction, as shown in Figure 20:

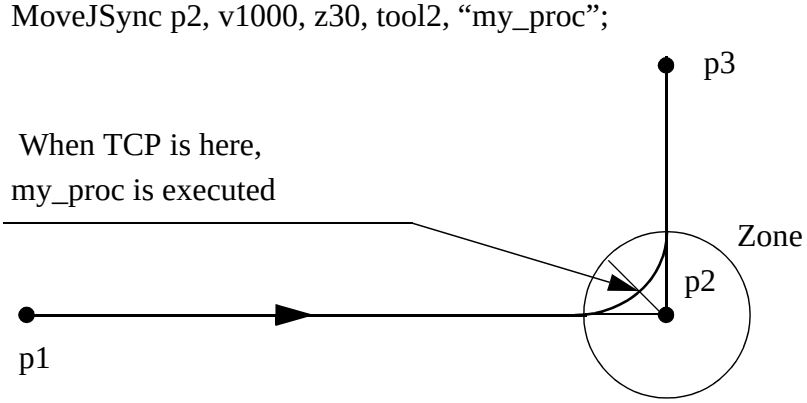


Figure 20 Execution of user-defined RAPID procedure in the middle of the corner path.

For stop points, we recommend the use of “normal” programming sequence with *MoveJ* + other RAPID instructions in sequence.

Execution of the specified RAPID procedure in different execution modes:

Execution mode:	Execution of RAPID procedure:
Continuously or Cycle	According to this description
Forward step	In the stop point
Backward step	Not at all

Limitation

Switching execution mode after program stop from continuously or cycle to stepwise forward or backward results in an error. This error tells the user that the mode switch can result in missed execution of a RAPID procedure in the queue for execution on the path. This error can be avoided if the program is stopped with StopInstr before the mode switch.

Instruction *MoveJSync* cannot be used on TRAP level.
The specified RAPID procedure cannot be tested with stepwise execution.

Syntax

MoveJSync
[ToPoint ’:=’] < expression (**IN**) of *robtarget* > ’,’
[’\’ ID ’:=’ < expression (**IN**) of *identno* >]’,’
[Speed ’:=’] < expression (**IN**) of *speeddata* >
[’\’ T ’:=’ < expression (**IN**) of *num* >] ’,’
[Zone ’:=’] < expression (**IN**) of *zonedata* >
[’\’ Z ‘:=’ < expression (**IN**) of *num* >] ’,’
[Tool ’:=’] < persistent (**PERS**) of *tooldata* >
[’\’ WObj ’:=’ < persistent (**PERS**) of *wobjdata* >] ’,’
[ProcName‘:=’] < expression (**IN**) of *string* >] ’;’

Related information

	Described in:
Other positioning instructions	RAPID Summary - Motion
Definition of velocity	Data Types - speeddata
Definition of zone data	Data Types - zonedata
Definition of tools	Data Types - tooldata
Definition of work objects	Data Types - wobjdata
Motion in general	Motion and I/O Principles
Coordinate systems	Motion and I/O Principles - Coordinate Systems

MoveL - Moves the robot linearly

MoveL is used to move the tool centre point (TCP) linearly to a given destination. When the TCP is to remain stationary, this instruction can also be used to reorientate the tool.

This instruction can only be used in the *Main* task or, if in a MultiMove System, in Motion tasks.

Example

MoveL p1, v1000, z30, tool2;

The TCP of the tool, *tool2*, is moved linearly to the position *p1*, with speed data *v1000* and zone data *z30*.

MoveL *, v1000\T:=5, fine, grip3;

The TCP of the tool, *grip3*, is moved linearly to a fine point stored in the instruction (marked with an *). The complete movement takes *5* seconds.

Arguments

MoveL [\Conc] ToPoint [\ID] Speed [\V] | [\T] Zone [\Z] [\Inpos] Tool [\WObj] [\Corr]

[\Conc] *(Concurrent)* Data type: *switch*

Subsequent instructions are executed while the robot is moving. The argument can be used to avoid unwanted stops, caused by overloaded CPU, when using fly-by points, and in this way shorten cycle time.This is useful when the programmed points are very close together at high speeds.The argument is also useful when, for example, communicating with external equipment and synchronisation between the external equipment and robot movement is not required.

Using the argument \Conc, the number of movement instructions in succession is limited to 5. In a program section that includes StorePath-RestoPath, movement instructions with the argument \Conc are not permitted.

If this argument is omitted and the ToPoint is not a stop point, the subsequent instruction is executed some time before the robot has reached the programmed zone.

This argument can not be used in coordinated synchronized movement in a MultiMove System.

ToPoint Data type: *robtarget*

The destination point of the robot and external axes. It is defined as a named position or stored directly in the instruction (marked with an * in the instruction).

[\ID] *(Synchronization id)* Data type: *identno*

This argument must be used in a MultiMove System, if coordinated synchronized movement, and is not allowed in any other cases.

The specified id number must be the same in all cooperating program tasks. The id number gives a guarantee that the movements are not mixed up at runtime.

Speed Data type: *speeddata*

The speed data that applies to movements. Speed data defines the velocity for the tool centre point, the tool reorientation and external axes.

[\V] *(Velocity)* Data type: *num*

This argument is used to specify the velocity of the TCP in mm/s directly in the instruction. It is then substituted for the corresponding velocity specified in the speed data.

[\T] *(Time)* Data type: *num*

This argument is used to specify the total time in seconds during which the robot moves. It is then substituted for the corresponding speed data.

Zone Data type: *zonedata*

Zone data for the movement. Zone data describes the size of the generated corner path.

[\Z] *(Zone)* Data type: *num*

This argument is used to specify the position accuracy of the robot TCP directly in the instruction. The length of the corner path is given in mm, which is substituted for the corresponding zone specified in the zone data.

[\Inpos] *(In position)* Data type: *stoppointdata*

This argument is used to specify the convergence criteria for the position of the robot's TCP in the stop point. The stop point data substitutes the zone specified in the *Zone* parameter.

Tool Data type: *tooldata*

The tool in use when the robot moves. The tool centre point is the point moved to the specified destination position.

[\WObj] *(Work Object)* Data type: *wobjdata*

The work object (coordinate system) to which the robot position in the instruction is related.

This argument can be omitted, and if it is, the position is related to the world coordinate system. If, on the other hand, a stationary tool or coordinated external axes are used, this argument must be specified in order to perform a linear movement relative to the work object.

[\Corr] *(Correction)* Data type: *switch*

Correction data written to a corrections entry by the instruction *CorrWrite* will be added to the path and destination position, if this argument is present.

Program execution

The robot and external units are moved to the destination position as follows:

- The TCP of the tool is moved linearly at constant programmed velocity.
- The tool is reoriented at equal intervals along the path.
- Uncoordinated external axes are executed at a constant velocity in order for them to arrive at the destination point at the same time as the robot axes.

If it is not possible to attain the programmed velocity for the reorientation or for the external axes, the velocity of the TCP will be reduced.

A corner path is usually generated when movement is transferred to the next section of a path. If a stop point is specified in the zone data, program execution only continues when the robot and external axes have reached the appropriate position.

Examples

MoveL *, v2000 \V:=2200, z40 \Z:=45, grip3;

The TCP of the tool, *grip3*, is moved linearly to a position stored in the instruction. The movement is carried out with data set to *v2000* and *z40*. The velocity and zone size of the TCP are *2200* mm/s and *45* mm respectively.

MoveL p5, v2000, fine \Inpos := inpos50, grip3;

The TCP of the tool, *grip3*, is moved linearly to a stop point *p5*. The robot considers it to be in the point when 50% of the position condition and 50% of the speed condition for a stop point *fine* are satisfied. It waits at most for 2 seconds for the conditions to be satisfied. See predefined data *inpos50* of data type *stoppointdata*.

MoveL \Conc, *, v2000, z40, grip3;

The TCP of the tool, *grip3*, is moved linearly to a position stored in the instruction. Subsequent logical instructions are executed while the robot moves.

MoveL start, v2000, z40, grip3 \WObj:=fixture;

The TCP of the tool, *grip3*, is moved linearly to a position, *start*. This position is specified in the object coordinate system for *fixture*.

Syntax

MoveL
[’\’ Conc ’,’]
[ToPoint ’:=’] < expression (**IN**) of *robtarget* > ’,’
[’\’ ID ’:=’ < expression (**IN**) of *identno* >]’,’
[Speed ’:=’] < expression (**IN**) of *speeddata* >
[’\’ V ’:=’ < expression (**IN**) of *num* >]
| [’\’ T ’:=’ < expression (**IN**) of *num* >] ’,’
[Zone ’:=’] < expression (**IN**) of *zonedata* >
[’\’ Z ’:=’ < expression (**IN**) of *num* >]
[’\’ Inpos ’:=’ < expression (**IN**) of *stoppointdata* >] ‘,’
[Tool ’:=’] < persistent (**PERS**) of *tooldata* >
[’\’ WObj ’:=’ < persistent (**PERS**) of *wobjdata* >]
[’\’ Corr]’;’

Related information

	Described in:
Other positioning instructions	RAPID Summary - Motion
Definition of velocity	Data Types - speeddata
Definition of zone data	Data Types - zonedata
Definition of stop point data	Data Types - stoppointdata
Definition of tools	Data Types - tooldata
Definition of work objects	Data Types - wobjdata
Writes to a corrections entry	Instructions - CorrWrite
Motion in general	Motion and I/O Principles
Coordinate systems	Motion and I/O Principles - Coordinate Systems
Concurrent program execution	Motion and I/O Principles - Synchronisation Using Logical Instructions

MoveLDO - Moves the robot linearly and sets digital output in the corner

MoveLDO (*Move Linearly Digital Output*) is used to move the tool centre point (TCP) linearly to a given destination. The specified digital output signal is set/reset at the middle of the corner path.

When the TCP is to remain stationary, this instruction can also be used to reorient the tool.

This instruction can only be used in the *Main* task or, if in a MultiMove System, in Motion tasks.

Example

MoveLDO p1, v1000, z30, tool2, do1,1;

The TCP of the tool, *tool2,* is moved linearly to the position *p1,* with speed data *v1000* and zone data *z30*. Output *do1* is set in the middle of the corner path at *p1*.

Arguments

MoveLDO ToPoint [\ID] Speed [\T] Zone Tool [\WObj] Signal Value

ToPoint Data type: *robtarget*

The destination point of the robot and external axes. It is defined as a named position or stored directly in the instruction (marked with an * in the instruction).

[\ID] *(Synchronization id)* Data type: *identno*

This argument must be used in a MultiMove System, if coordinated synchronized movement, and is not allowed in any other cases.

The specified id number must be the same in all cooperating program tasks. The id number gives a guarantee that the movements are not mixed up at runtime.

Speed Data type: *speeddata*

The speed data that applies to movements. Speed data defines the velocity for the tool centre point, the tool reorientation and external axes.

[\T] *(Time)* Data type: *num*

This argument is used to specify the total time in seconds during which the robot moves. It is then substituted for the corresponding speed data.

Zone Data type: *zonedata*

Zone data for the movement. Zone data describes the size of the generated corner path.

Tool Data type: *tooldata*

The tool in use when the robot moves. The tool centre point is the point moved to the specified destination position.

[\WObj] *(Work Object)* Data type: *wobjdata*

The work object (coordinate system) to which the robot position in the instruction is related.

This argument can be omitted, and if it is, the position is related to the world coordinate system. If, on the other hand, a stationary TCP or coordinated external axes are used, this argument must be specified.

Signal Data type: *signaldo*

The name of the digital output signal to be changed.

Value Data type: *dionum*

The desired value of signal (0 or 1).

Program execution

See the instruction *MoveL* for more information about linear movements.

The digital output signal is set/reset in the middle of the corner path for flying points, as shown in Figure 21.

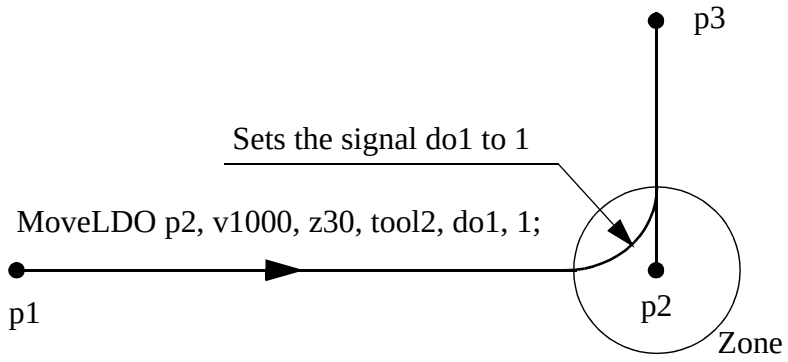


Figure 21 Set/Reset of digital output signal in the corner path with MoveLDO.

For stop points, we recommend the use of “normal” programming sequence with *MoveL* + *SetDO*. But when using stop point in instruction *MoveLDO*, the digital output

signal is set/reset when the robot reaches the stop point.

The specified I/O signal is set/reset in execution mode continuously and stepwise forward but not in stepwise backward.

Syntax

```
MoveLDO
   [ ToPoint ':=' ] < expression (IN) of robtarget > ','
   [ '\' ID ':=' < expression (IN) of identno >]','
   [ Speed ':=' ] < expression (IN) of speeddata >
                  [ '\' T ':=' < expression (IN) of num > ] ','
   [ Zone ':=' ] < expression (IN) of zonedata > ','
   [ Tool ':=' ] < persistent (PERS) of tooldata >
   [ '\' WObj ':=' < persistent (PERS) of wobjdata > ] ','
   [ Signal ':=' ] < variable (VAR) of signaldo>] ','
   [ Value ':=' ] < expression (IN) of dionum > ] ';'
```

Related information

	Described in:
Other positioning instructions	RAPID Summary - Motion
Definition of velocity	Data Types - speeddata
Definition of zone data	Data Types - zonedata
Definition of tools	Data Types - tooldata
Definition of work objects	Data Types - wobjdata
Motion in general	Motion and I/O Principles
Coordinate systems	Motion and I/O Principles - Coordinate Systems
Movements with I/O settings	Motion and I/O Principles - Synchronisation Using Logical Instructions

MoveLSync - Moves the robot linearly and executes a RAPID procedure

MoveLSync (*Move Linearly Synchronously*) is used to move the tool centre point (TCP) linearly to a given destination.The specified RAPID procedure is executed at the middle of the corner path in the destination point.

When the TCP is to remain stationary, this instruction can also be used to reorient the tool.

This instruction can only be used in the *Main* task or, if in a MultiMove System, in Motion tasks.

Example

MoveLSync p1, v1000, z30, tool2, “proc1”;

The TCP of the tool, *tool2,* is moved linearly to the position *p1*, with speed data *v1000* and zone data *z30*. Procedure *proc1* is executed in the middle of the corner path at *p1*.

Arguments

MoveLSync ToPoint [\ID] Speed [\T] Zone Tool [\WObj] ProcName

ToPoint Data type: *robtarget*

The destination point of the robot and external axes. It is defined as a named position or stored directly in the instruction (marked with an * in the instruction).

[\ID] *(Synchronization id)* Data type: *identno*

This argument must be used in a MultiMove System, if coordinated synchronized movement, and is not allowed in any other cases.

The specified id number must be the same in all cooperating program tasks. The id number gives a guarantee that the movements are not mixed up at runtime.

Speed Data type: *speeddata*

The speed data that applies to movements. Speed data defines the velocity for the tool centre point, the tool reorientation and external axes.

[\T] *(Time)* Data type: *num*

This argument is used to specify the total time in seconds during which the robot moves. It is then substituted for the corresponding speed data.

Zone Data type: *zonedata*

Zone data for the movement. Zone data describes the size of the generated corner path.

Tool Data type: *tooldata*

The tool in use when the robot moves. The tool centre point is the point moved to the specified destination position.

[\WObj] *(Work Object)* Data type: *wobjdata*

The work object (coordinate system) to which the robot position in the instruction is related.

This argument can be omitted, and if it is, the position is related to the world coordinate system. If, on the other hand, a stationary TCP or coordinated external axes are used, this argument must be specified.

ProcName *(Procedure Name)* Data type: *string*

Name of the RAPID procedure to be executed at the middle of the corner path in the destination point.

Program execution

See the instruction *MoveL* for more information about linear movements.

The specified RAPID procedure is executed when the TCP reaches the middle of the corner path in the destination point of the *MoveLSync* instruction, as shown in Figure 22:

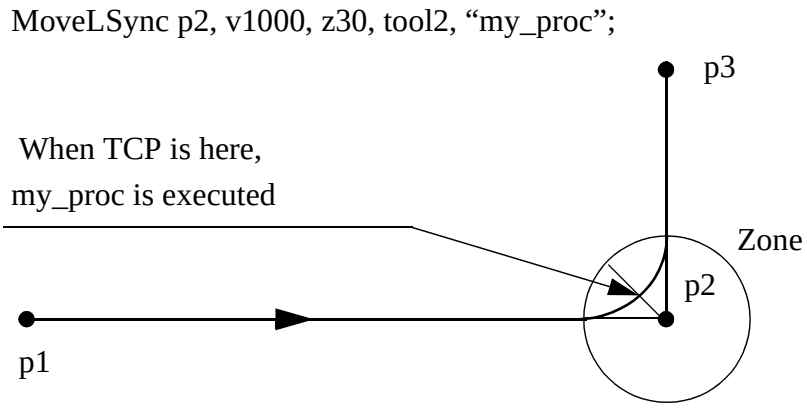


Figure 22 Execution of user-defined RAPID procedure in the middle of the corner path.

For stop points, we recommend the use of “normal” programming sequence with *MoveL* + other RAPID instructions in sequence.

Execution of the specified RAPID procedure in different execution modes:

Execution mode:	Execution of RAPID procedure:
Continuously or Cycle	According to this description
Forward step	In the stop point
Backward step	Not at all

Limitation

Switching execution mode after program stop from continuously or cycle to stepwise forward or backward results in an error. This error tells the user that the mode switch can result in missed execution of a RAPID procedure in the queue for execution on the path. This error can be avoided if the program is stopped with StopInstr before the mode switch.

Instruction *MoveLSync* cannot be used on TRAP level.
The specified RAPID procedure cannot be tested with stepwise execution.

Syntax

MoveLSync
[ToPoint ':='] < expression (**IN**) of *robtarget* > ','
['\' ID ':=' < expression (**IN**) of *identno* >]','
[Speed ':='] < expression (**IN**) of *speeddata* >
['\' T ':=' < expression (**IN**) of *num* >] ','
[Zone ':='] < expression (**IN**) of *zonedata* > ','
[Tool ':='] < persistent (**PERS**) of *tooldata* >
['\' WObj ':=' < persistent (**PERS**) of *wobjdata* >] ','
[ProcName':='] < expression (**IN**) of *string* >] ';'

Related information

	Described in:
Other positioning instructions	RAPID Summary - Motion
Definition of velocity	Data Types - speeddata
Definition of zone data	Data Types - zonedata
Definition of tools	Data Types - tooldata
Definition of work objects	Data Types - wobjdata
Motion in general	Motion and I/O Principles
Coordinate systems	Motion and I/O Principles - Coordinate Systems

MToolRotCalib - Calibration of rotation for moving tool

MToolRotCalib (Moving Tool Rotation Calibration) is used to calibrate the rotation of a moving tool.

The position of the robot and its movements are always related to its tool coordinate system, i.e. the TCP and tool orientation. To get the best accuracy, it is important to define the tool coordinate system as correctly as possible.

The calibration can also be done with a manual method using the FlexPendant (described in User's Manual - *Calibration*).

Description

To define the tool orientation, you need a world fixed tip within the robot's working space.

Before using the instruction *MToolRotCalib*, some preconditions must be fulfilled:

- The tool that is to be calibrated must be mounted on the robot and defined with correct component *robhold* (*TRUE*).
- If using the robot with absolute accuracy, the load and centre of gravity for the tool should already be defined.
  LoadIdentify can be used for the load definition.
- The TCP value of the tool must already be defined. The calibration can be done with the instruction *MToolTCPCalib*.
- *Tool0*, *wobj0* and *PDispOff* must be activated before jogging the robot.
- Jog the TCP of the actual tool as close as possible to the world fixed tip (origin of the tool coordinate system) and define a *jointtarget* for the reference point *RefTip*.
- Jog the robot without changing the tool orientation so the world fixed tip is pointing at some point on the positive z-axis of the tool coordinate system and define a *jointtarget* for point *ZPos*.
- Jog optionally the robot without changing the tool orientation so the world fixed tip is pointing at some point on the positive x-axis of the tool coordinate system and define a *jointtarget* for point *XPos*.

As a help for pointing out the positive z-axis and x-axis, some type of elongator tool can be used.

Notice that you must not modify the positions RefTip, ZPos and XPos in the instruction *MToolRotCalib*, while the tool used in the creation of the points is not the same as the tool being calibrated.

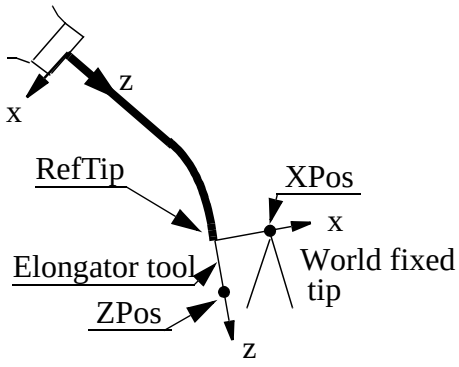


Figure 23 Definition of jointtarget for RefTip, ZPos and optional XPos

Example

```
! Created with the world fixed tip pointing at origin, positive z-axis and positive
! x-axis.
CONST jointtarget pos_tip := [...];
CONST jointtarget pos_z := [...];
CONST jointtarget pos_x := [...];

PERS tooldata tool1:= [ TRUE, [[20, 30, 100], [1, 0, 0 ,0]],
                [0.001, [0, 0, 0.001], [1, 0, 0, 0], 0, 0, 0]];

! Instructions for creating or ModPos of pos_tip, pos_z and pos_x
MoveAbsJ pos_tip, v10, fine, tool0;
MoveAbsJ pos_z, v10, fine, tool0;
MoveAbsJ pos_x, v10, fine, tool0;

Only tool calibration in the z direction
MToolRotCalib pos_tip, pos_z, tool1;
```

The tool orientation (*tframe.rot*) in the z direction of *tool1* is calculated. The x and y directions of the tool orientation are calculated to coincide with the wrist coordinate system.

```
Calibration with complete tool orientation
MToolRotCalib pos_tip, pos_z \XPos:=pos_x, tool1;
```

The tool orientation (*tframe.rot*) of *tool1* is calculated.

Arguments

MToolRotCalib RefTip ZPos [\XPos]Tool

RefTip Data type: *jointtarget*

The reference tip point.

ZPos Data type: *jointtarget*

The elongator point that defines the positive z direction.

[\XPos] Data type: *jointtarget*

The elongator point that defines the x positive direction. If this point is omitted, the x and y directions of the tool will coincide with the corresponding axes in the wrist coordinate system.

Tool Data type: *tooldata*

The name of the tool that is to be calibrated.

Program execution

The system calculates and updates the tool orientation (*tfame.rot*) in the specified *tool-data*. The calculation is based on the specified 2 or 3 *jointtarget*. The remaining data in tooldata such as TCP (*tframe.trans*) is not changed.

Syntax

MToolRotCalib
[RefTip ':='] < expression (**IN**) of *jointtarget* > ','
[ZPos ':='] < expression (**IN**) of *jointtarget* >
['\'XPos ':=' < expression (**IN**) of *jointtarget* >] ','
[Tool ':='] < persistent (**PERS**) of *tooldata* > ';'

Related information

	Described in:
Calibration of TCP for a moving tool	Instructions - MToolTCPCalib
Calibration of TCP for a stationary tool	Instructions - SToolTCPCalib
Calibration TCP and rotation	Instructions - SToolRotCalib for a stationary tool

MToolTCPCalib - Calibration of TCP for moving tool

MToolTCPCalib (Moving Tool TCP Calibration) is used to calibrate Tool Centre Point - TCP for a moving tool.

The position of the robot and its movements are always related to its tool coordinate system, i.e. the TCP and tool orientation. To get the best accuracy, it is important to define the tool coordinate system as correctly as possible.

The calibration can also be done with a manual method using the FlexPendant (described in User's Manual - *Calibration*).

Description

To define the TCP of a tool, you need a world fixed tip within the robot's working space.

Before using the instruction *MToolTCPCalib*, some preconditions must be fulfilled:

- The tool that is to be calibrated must be mounted on the robot and defined with correct component *robhold* (*TRUE*).
- If using the robot with absolute accuracy, the load and centre of gravity for the tool should already be defined.
  LoadIdentify can be used for the load definition.
- *Tool0*, *wobj0* and *PDispOff* must be activated before jogging the robot.
- Jog the TCP of the actual tool as close as possible to the world fixed tip and define a *jointtarget* for the first point p1.
- Define a further three positions p2, p3, and p4, all with different orientations.

Notice that you must not modify the positions Pos1 to Pos4 in the instruction *MToolTCPCalib*, while the tool used in the creation of the points is not the same as the tool being calibrated.

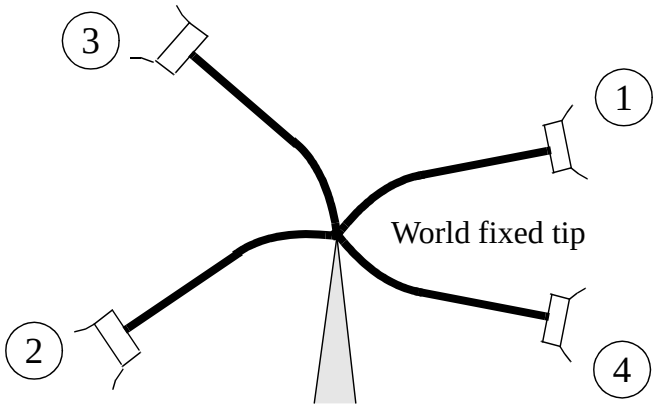


Figure 24 Definition of 4 jointtargets p1 ... p4.

Example

```
! Created with actual TCP pointing at the world fixed tip
CONST jointtarget p1 := [...];
CONST jointtarget p2 := [...];
CONST jointtarget p3 := [...];
CONST jointtarget p4 := [...];

PERS tooldata tool1:= [ TRUE, [[0, 0, 0], [1, 0, 0 ,0]],
                [0.001, [0, 0, 0.001], [1, 0, 0, 0], 0, 0, 0]];
VAR num max_err;
VAR num mean_err;
...
! Instructions for createing or ModPos of p1 - p4
MoveAbsJ p1, v10, fine, tool0;
MoveAbsJ p2, v10, fine, tool0;
MoveAbsJ p3, v10, fine, tool0;
MoveAbsJ p4, v10, fine, tool0;
...
MToolTCPCalib p1, p2, p3, p4, tool1, max_err, mean_err;
```

The TCP value (*tframe.trans*) of *tool1* will be calibrated and updated.
max_err and *mean_err* will hold the max. error in mm from the calculated TCP and the mean error in mm from the calculated TCP, respectively.

Arguments

MToolTCPCalib Pos1 Pos2 Pos3 Pos4 Tool MaxErr MeanErr

Pos1 Data type: *jointtarget*

The first approach point.

Pos2 Data type: *jointtarget*

The second approach point.

Pos3 Data type: *jointtarget*

The third approach point.

Pos4 Data type: *jointtarget*

The fourth approach point.

Tool Data type: *tooldata*

The name of the tool that is to be calibrated.

MaxErr Data type: *num*

The maximum error in mm for one approach point.

MeanErr Data type: *num*

The average distance that the approach points are from the calculated TCP, i.e. how accurately the robot was positioned relative to the tip.

Program execution

The system calculates and updates the TCP value in the wrist coordinate system (*tfame.trans*) in the specified *tooldata*. The calculation is based on the specified 4 *joint-target*. The remaining data in tooldata, such as tool orientation (*tframe.rot*), is not changed.

Syntax

MToolTCPCalib
[Pos1 ':='] < expression (**IN**) of *jointtarget* > ','
[Pos2 ':='] < expression (**IN**) of *jointtarget* > ','
[Pos3 ':='] < expression (**IN**) of *jointtarget* > ','
[Pos4 ':='] < expression (**IN**) of *jointtarget* > ','
[Tool ':='] < persistent (**PERS**) of *tooldata* > ','
[MaxErr ':='] < variable (**VAR**) of *num* > ','
[MeanErr ':='] < variable (**VAR**) of *num* > ';'

Related information

	Described in:
Calibration of rotation for a moving tool	Instructions - MToolRotCalib
Calibration of TCP for a stationary tool	Instructions - SToolTCPCalib
Calibration of TCP and rotation	Instructions - SToolRotCalib for a stationary tool

Open - Opens a file or serial channel

Open is used to open a file or serial channel for reading or writing.

Example

```
VAR iodev logfile;
...
Open "HOME:" \File:= "LOGFILE1.DOC", logfile \Write;
```

The file *LOGFILE1.DOC* in unit *HOME:*, is opened for writing. The reference name *logfile* is used later in the program when writing to the file.

Arguments

Open Object [\File] IODevice [\Read] | [\Write] | [\Append] [\Bin]

Object Data type: *string*

The I/O object (I/O device) that is to be opened, e.g. "HOME:", "TEMP:", “com1:” or “pc:”(option).

Table 8 Different I/O device on the Robot Controller

I/O device name	Full file path	Type of I/O device
"HOME:" or diskhome[1]	"/hd0a/xxxx/HOME/"[2]	Flashdisk or Hard Drive
"TEMP:" or disktemp1	"/hd0a/temp/"	Flashdisk or Hard Drive
"RemovableDisk1:" or usbdisk11 "RemovableDisk2:" or usbdisk21 "RemovableDisk3:" or usbdisk31 "RemovableDisk4:" or usbdisk41	“/bd0/” “/bd1/” “/bd2/” “/bd3/”	e.g. USB memory stick[3]
"com1:"[4]	-	Serial channel
“pc:”[5]	“/c:/temp/”[6]	Mounted disk

1. RAPID string defining device name
2. “xxxx” means the system name, defined when booting the system
3. Note! RemovableDisk1 could be e.g. USB memory on one system, but USB floppy on another.
4. Use defined serial channel name, defined in system parameters
5. Application protocol, server path, defined in system parameters
6. Application protocol, server path, defined in system parameters

Table 9 Different I/O device on the Virtual Controller

Table 10

I/O device name	Full file path	Type of I/O device
"HOME:" or diskhome[1]	"/xxxx/HOME/"[2]	
"TEMP:" or disktemp1	"/c:/temp/yyyy/"[3]	Hard Drive
"RemovableDisk1:" or usbdisk11 "RemovableDisk2:" or usbdisk21 "RemovableDisk3:" or usbdisk31 "RemovableDisk4:" or usbdisk41	"/xxxx/HOME/RemovableDisk1/" "/xxxx/HOME/RemovableDisk2/" "/xxxx/HOME/RemovableDisk3/" "/xxxx/HOME/RemovableDisk4/"	e.g. USB memory stick[4]

1. RAPID string defining the device name
2. “xxxx” means the path to the system directory, defined when creating the system
3. “yyyy” means a directory named as System ID
4. Note! RemovableDisk1 could be e.g. USB memory on one system, but USB floppy on another.

[\File] Data type: *string*

The name of the file to be opened, e.g. "LOGFILE1.DOC" or "LOGDIR/LOGFILE1.DOC"

The complete path can also be specified in the argument *Object*, “HOME:/LOGDIR/LOGFILE.DOC".

IODevice Data type: *iodev*

A reference to the file or serial channel to open. This reference is then used for reading from and writing to the file or serial channel.

[\Read] Data type: *switch*

Opens a file or serial channel for reading. When reading from a file, the reading is started from the beginning of the file.

[\Write] Data type: *switch*

Opens a file or serial channel for writing. If the selected file already exists, its contents are deleted. Anything subsequently written is written at the start of the file.

[\Append] Data type: *switch*

Opens a file or serial channel for writing. If the selected file already exists, anything subsequently written is written at the end of the file.

Open a file or serial channel with *\Append* and without the *\Bin* arguments. The instruction opens a character-based file or serial channel for writing.

Open a file or serial channel with *\Append* and *\Bin* arguments. The instruction opens a binary file or serial channel for both reading and writing.
The arguments *\Read*, *\Write*, *\Append* are mutually exclusive. If none of these are specified, the instruction acts in the same way as the *\Write* argument for character-based files or a serial channel (instruction without *\Bin* argument) and in the same way as the *\Append* argument for binary files or a serial channel (instruction with *\Bin* argument).

[\Bin] Data type: *switch*

The file or serial channel is opened in a binary mode.
If none of the arguments *\Read*, *\Write* or *\Append* are specified, the instruction opens a binary file or serial channel for both reading and writing, with the file pointer at the end of the file

The set of instructions to access a binary file or serial channel is different from the set of instructions to access a character-based file.

Example

```
VAR iodev printer;
...
Open "com2:", printer \Bin;
WriteStrBin printer, "This is a message to the printer\0D";
Close printer;
```

The serial channel *com2:* is opened for binary reading and writing.
The reference name *printer* is used later when writing to and closing the serial channel.

Program execution

The specified file or serial channel is opened so that it is possible to read from or write to it.

It is possible to open the same physical file several times at the same time, but each invocation of the *Open* instruction will return a different reference to the file (data type *iodev*). E.g. it is possible to have one write pointer and one different read pointer to the same file at the same time.

The *iodev* variable used when opening a file or serial channel must be free from use. If it has been used previously to open a file, this file must be closed prior to issuing a new *Open* instruction with the same *iodev* variable.

Error handling

If a file cannot be opened, the system variable ERRNO is set to ERR_FILEOPEN. This error can then be handled in the error handler.

Syntax

```
Open
    [Object ':='] <expression (IN) of string>
    ['\'File':=' <expression (IN) of string>] ','
    [IODevice ':='] <variable (VAR) of iodev>
    ['\'Read] | ['\'Write] | ['\'Append]
    ['\'Bin] ';'
```

Related information

	Described in:
Writing to and reading from	RAPID Summary - Communication files or serial channel

OpenDir - Open a directory

OpenDir is used to open a directory for further investigation.

Example

```
PROC lsdir(string dirname)
                    VAR dir directory;
                    VAR string filename;
                    OpenDir directory, dirname;
                    WHILE ReadDir(directory, filename) DO
                            TPWrite filename;
                    ENDWHILE
                    CloseDir directory;
ENDPROC
```

This example prints out the names of all files or subdirectories under the specified directory.

Arguments

OpenDir **Dev Path**

Dev Data type: *dir*

A variable with reference to the directory, fetch by *OpenDir*.
This variable is then used for reading from the directory.

Path Data type: *string*

Path to the directory.

Limitations

Open directories should always be closed by the user after reading (instruction *CloseDir*).

Error handling

If the path points to a not existing directory or if there are too many directories open at the same time, the system variable ERRNO is set to ERR_FILEACC. This error can then be handled in the error handler.

Syntax

```
OpenDir
   [ Dev':=' ] < variable (VAR) of dir>','
                [ Path':=' ] < expression (IN) of string>';'
```

Related information

	Described in:
Directory	dir
Read a directory	ReadDir
Close a directory	CloseDir
Check file type	IsFile

PackDNHeader - Pack DeviceNet Header into rawbytes data

PackDNHeader is used to pack the header of a DeviceNet explicit message into a 'container' of type rawbytes.

The data part of the DeviceNet message can afterwards be set with the instruction *PackRawBytes*.

Example

VAR rawbytes raw_data;

PackDNHeader "0E", "6,20 01 24 01 30 06,9,4", raw_data;

Pack the header for DeviceNet explicit message with service code "0E" and path string "*6,20 01 24 01 30 06,9,4*" into *raw_data* corresponding to get the serial number from some I/O unit.

This message is ready to send without filling the message with additional data.

VAR rawbytes raw_data;

PackDNHeader "10", "20 1D 24 01 30 64", raw_data;

Pack the header for DeviceNet explicit message with service code "*10*" and path string "*20 1D 24 01 30 64*" into *raw_data* corresponding to set the filter time for the rising edge on insignal 1 for some I/O unit.

This message must be increased with data for the filter time.
This can be done with instruction *PackRawBytes* starting at index *RawBytesLen*(raw_data)+1 (done after *PackDNHeader*).

Arguments

PackDNHeader Service Path RawData

Service Data type: *string*

The service to be done such as get or set attribute.
To be specified with a hexadecimal code in a string e.g. "1F"

String length: 2 characters
Format: '0' - '9', 'a' -'f', 'A' - 'F'
Range: "00" - "FF

The values for the *Service* is found in the EDS file. For a more detailed description see the Open DeviceNet Vendor Association "*DeviceNet Specification rev. 2.0"*.

Path Data type: *string*

The values for the *Path* is found in the EDS file. For a more detailed description see the Open DeviceNet Vendor Association “*DeviceNet Specification rev. 2.0”*.

Support for both long string format (e.g. "6,20 1D 24 01 30 64,8,1") and short string format (e.g. "20 1D 24 01 30 64").

RawData Data type: *rawbytes*

Variable container to be packed with message header data starting at index 1 in *RawData*.

Program execution

During program execution the DeviceNet message *RawData* ‘container’is:

- first completly cleared
- and then the header part is packed with data

Format DeviceNet Header

The instruction *PackDNHeader* will create a DeviceNet message header with following format:

Tabell 11

RawData Header Format	No of bytes	Note
Format	1	Internal IRC5 code for DeviceNet
Service	1	Hex code for service
Size of Path	1	In bytes
Path	x	ASCII chars

The data part of the DeviceNet message can afterwards be set with the instruction *PackRawBytes* starting at index fetched with (*RawBytesLen*(my_rawdata)+1).

Syntax

PackDNHeader
[Service ’:=’] < expression (**IN**) of s*tring*> ’,’
[Path ’:=’] < expression (**IN**) of s*tring*> ’,’
[RawData ’:=’] < variable (**VAR**) of *rawbytes*> ’;’

Related information

Tabell 12

	Described in:
rawbytes data	Data Types - *rawbytes*
Get the length of *rawbytes* data	Functions - *RawBytesLen*
Clear the contents of *rawbytes* data	Instructions - *ClearRawBytes*
Copy the contents of *rawbytes* data	Instructions - *CopyRawBytes*
Pack data to *rawbytes* data	Instructions - *PackRawBytes*
Write *rawbytes* data	Instructions - *WriteRawBytes*
Read *rawbytes* data	Instructions - *ReadRawBytes*
Unpack data from *rawbytes* data	Instructions - *UnpackRawBytes*
Bit/Byte Functions	RAPID Summary - Bit Functions
String functions	RAPID Summary - String Functions

PackRawBytes - Pack data into rawbytes data

PackRawBytes is used to pack the contents of variables of type num, byte or string into a ‘container’ of type rawbytes.

Example

```
VAR rawbytes raw_data;
VAR num integer := 8;
VAR num float := 13.4;
VAR byte data1 := 122;
VAR byte byte1;
VAR string string1:=”abcdefg”;

PackDNHeader “10”, "20 1D 24 01 30 64", raw_data;
```

Pack the header for DeviceNet explicit message with service code and path string according EDS-file into *raw_data*.

Then pack requested field bus data in *raw_data* with *PackRawBytes*.
The example below shows how different data can be added.

```
PackRawBytes integer, raw_data, (RawBytesLen(raw_data) \IntX := DINT;
```

The contents of the next 4 bytes after the header in *raw_data* will be 8 decimal.

```
PackRawBytes float, raw_data, (RawBytesLen(raw_data)+1) \Float4;
```

The contents of the next 4 bytes in *raw_data* will be 13.4 decimal.

```
PackRawBytes data1, raw_data, (RawBytesLen(raw_data)+1) \ASCII;
```

The contents of the next byte in *raw_data* will be 122, the ASCII code for “z”.

```
PackRawBytes string1, raw_data, (RawBytesLen(raw_data)+1) \ASCII;
```

The contents of next 7 bytes in *raw_data* will be “abcdefg”, coded in ASCII.

```
byte1 := StrToByte(“1F” \Hex);
PackRawBytes byte1, raw_data, (RawBytesLen(raw_data)+1) \Hex1;
```

The contents of the next byte in *raw_data* will be “1F”, hexadecimal.

Arguments

PackRawBytes **Value RawData [\Network] StartIndex [\Hex1] | [\IntX] | [\Float4] | [\ASCII]**

Value Data type: *anytype*

Variable containing the data to be packed into *RawData*.

Allowed data types are: *num*, *byte* or *string*.

RawData Data type: *rawbytes*

Variable container to be packed with data.

[\Network] Data type: *switch*

Indicates that integer and float shall be packed in big-endian (network order) representation in *RawData*. ProfiBus and InterBus use big-endian.

Without this switch, integer and float will be packed in little-endian (not network order) representation in *RawData*. DeviceNet use little-endian.

Only relevant together with option parameter *\IntX - UINT, UDINT, INT, DINT* and *\Float4*.

StartIndex Data type: *num*

StartIndex, between 1 and 1024, indicates where the first byte contained in *Value* shall be placed in *RawData*.

[\Hex1] Data type: *switch*

The *Value* to be packed has *byte* format and shall be converted to hexadecimal format and stored in 1 byte in *RawData*.

[\IntX] Data type: *inttypes*

The *Value* to be packed has *num* format, is an integer and shall be stored according the specified constant of data type *inttypes*, in *RawData*.

See predefined data below.

[\Float4] Data type: *switch*

The *Value* to be packed has *num* format and shall be stored as float, 4 bytes, in *RawData*.

[\ASCII] Data type: *switch*

The *Value* to be packed has *byte* or *string* format.

If the *Value* to be packed has *byte* format, it will be stored in *RawData* as 1 byte

interpreting *Value* as ASCII code for a character.

If the *Value* to be packed has *string* format (1-80 characters), it will be stored in *RawData* as ASCII characters with the same number of characters as contained in *Value*. String data is not NULL terminated by the system in data of type *rawbytes*. It is up to the programmer to add string header if necessary (required for DeviceNet).

One of argument *\Hex1*, *\IntX*, *\Float4* or *\ASCII* must be programmed.

The following combinations are allowed:

Tabell 13

Data type of *Value*:	Allowed option parameters:
num *)	\IntX
num	\Float4
string	\ASCII (1-80 characters)
byte	\Hex1 \ASCII

*) Must be integer within the value range of selected symbolic constant USINT, UINT, UDINT, SINT, INT or DINT.

Program execution

During program execution data is packed from the variable of type *anytype* into a ‘container’ of type *rawbytes*.

The current length of valid bytes in the *RawData* variable is set to:

- (*StartIndex* + packed_number_of_bytes - 1)
- The current length of valid bytes in the *RawData* variable is not changed , if the complete pack operation is done inside the old current length of valid bytes in the *RawData* variable.

Predefined data

The following symbolic constants of the data type *inttypes* are predefined and can be used to specify the integer in parameter *\IntX*.

Tabell 14

Symbolic constant	Constant value	Integer format	Integer value range
USINT	1	Unsigned 1 byte integer	0 ... 255
UINT	2	Unsigned 2 byte integer	0 ... 65 535
UDINT	4	Unsigned 4 byte integer	0 - 8 388 608 *)
SINT	- 1	Signed 1 byte integer	- 128 ... 127
INT	- 2	Signed 2 byte integer	- 32 768 ... 32 767
DINT	- 4	Signed 4 byte integer	- 8 388 607 ... 8 388 608 *)

*) RAPID limitation for storage of integer in data type *num*.

Syntax

```
PackRawBytes
   [Value ':=' ] < variable (VAR) of anytype> ','
   [RawData ':=' ] < variable (VAR) of rawbytes>
      [ '\' Network ] ','
   [StartIndex ':=' ] < expression (IN) of num>
   [ '\' Hex1 ] | [ '\' IntX ':=' < expression (IN) of inttypes>]
                | [ '\' Float4 ] | [ '\' ASCII] ';'
```

Related information

Tabell 15

	Described in:
rawbytes data	Data Types - *rawbytes*
Get the length of *rawbytes* data	Functions - *RawBytesLen*
Clear the contents of *rawbytes* data	Instructions - *ClearRawBytes*
Copy the contents of *rawbytes* data	Instructions - *CopyRawBytes*
Pack DeviceNet header into *rawbytes* data	Instructions - *PackDNHeader*
Write *rawbytes* data	Instructions - *WriteRawBytes*
Read *rawbytes* data	Instructions - *ReadRawBytes*
Unpack data from *rawbytes* data	Instructions - *UnpackRawBytes*
Bit/Byte Functions	RAPID Summary - Bit Functions
String functions	RAPID Summary - String Functions

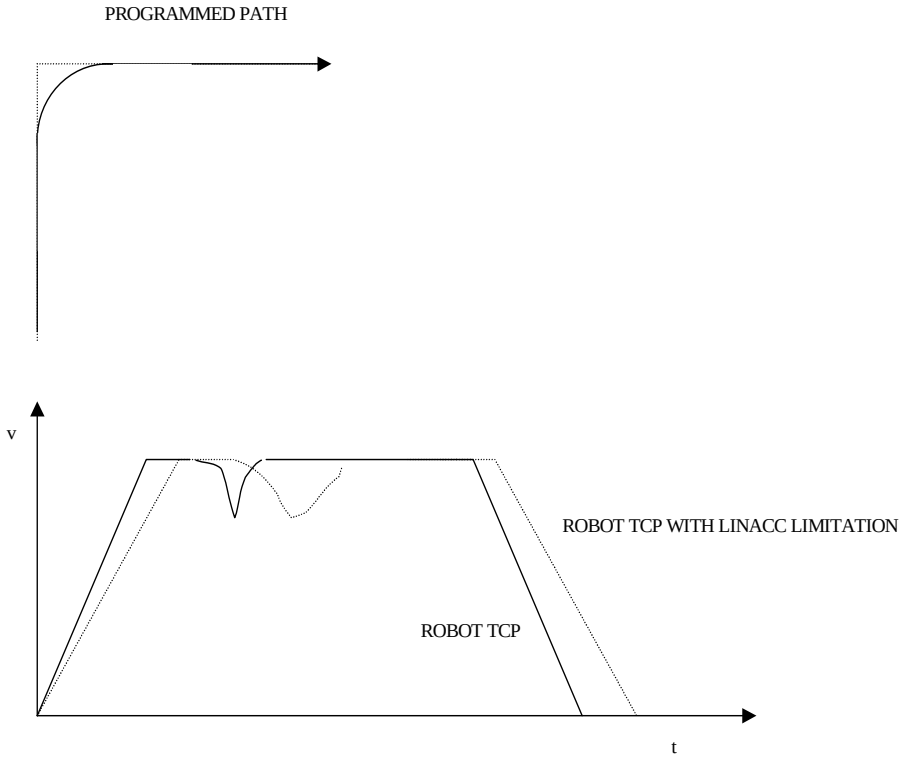
PathAccLim - Reduce TCP acceleration along the path

PathAccLim (Path Acceleration Limitation) is used to set or reset limitations on TCP acceleration and/or TCP deceleration along the movement path.

The limitation will be performed along the movement path, i.e the acceleration in the path frame. It is the tangential acceleration/deceleration in the path direction that will be limited.

The instruction does not limit the total acceleration of the equipment, i.e. the acceleration in world frame, so it can not be directly used to protect the equipment from large accelerations.

This instruction can only be used in the *Main* task or, if in a MultiMove System, in Motion tasks.



Example

PathAccLim TRUE \AccMax := 4, TRUE \AccMin := 4;

TCP acceleration and TCP deceleration is limited to $4 m/s^2$.

PathAccLim FALSE, FALSE;

The TCP acceleration and deceleration is reset to maximum (default).

Arguments

PathAccLim AccLim [\AccMax] DecelLim [\DecelMax]

AccLim Data type: *bool*

TRUE if there is to be a limitation of the acceleration, FALSE otherwise.

[\AccMax] Data type: *num*

The absolute value of the acceleration limitation in m/s^2. Only to be used when *AccLim* is TRUE.

DecelLim Data type: *bool*

TRUE if there is to be a limitation of the deceleration, FALSE otherwise.

[\DecelMax] Data type: *num*

The absolute value of the deceleration limitation in m/s^2. Only to be used when *DecelLim* is TRUE.

Program execution

The acceleration/deceleration limitations applies for the next executed robot segment and is valid until a new *PathAccLim* instruction is executed.

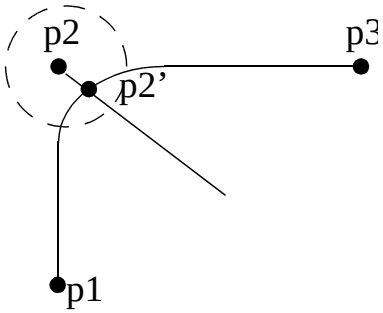
The maximum acceleration/deceleration (PathAccLim FALSE, FALSE) are automatically set

- at a cold start-up
- when a new program is loaded
- when starting program executing from the beginning.

If combination of instruction *AccSet* and *PathAccLim*, the system reduce the acceleration/deceleration in following order

- according *AccSet*
- according *PathAccLim*

Example



MoveL p1, v1000, fine, tool0;
PathAccLim TRUE\AccMax := 4, FALSE;
MoveL p2, v1000, z30, tool0;
MoveL p3, v1000, fine, tool0;
PathAccLim FALSE, FALSE;

TCP acceleration is limited to $4 m/s^2$ between p1 and p3.

MoveL p1, v1000, fine, tool0;
MoveL p2, v1000, z30, tool0;
PathAccLim **TRUE\AccMax :=3**, TRUE\DecelMax := 4;
MoveL p3, v1000, fine, tool0;
PathAccLim FALSE, FALSE;

TCP acceleration is limited to $3 m/s^2$ between p2’ and p3
TCP deceleration is limited to $4 m/s^2$ between p2’ and p3

Limitations

The minimum acceleration/deceleration allowed is 0.5 m/s^2.

Error handling

If the parameters *AccMax* or *DecelMax* is set to a value too low, the system variable ERRNO is set to ERR_ACC_TOO_LOW. This error can then be handled in the error handler.

Syntax

PathAccLim
[AccLim ’:=’] < expression (**IN**) of *bool* >
[‘\’AccMax ’:=’ <expression (**IN**) of *num* >]’,’
[DecelLim ’:=’] < expression (**IN**) of *bool*>
[‘\’DecelMax ‘:=’ <expression (**IN**) of *num* >]’;’

Related information

	Described in:
Positioning instructions	RAPID Summary - Motion
Motion settings data	Data Types - motsetdata
Reduction of acceleration	Instructions - AccSet

PathRecMoveBwd - Move path recorder backwards

PathRecMoveBwd is used to move the robot backwards along a recorded path.

Example

```
VAR pathrecid fixture_id;
PathRecMoveBwd \ID:=fixture_id \ToolOffs:=[0, 0, 10] \Speed:=v500;
```

The robot is moved backwards to the position in the program where the instruction *PathRecStart* planted the *fixture_id* identifier. The TCP offset is 10 mm in Z direction and the speed is set to 500 mm/s.

Arguments

PathRecMoveBwd [\ID] [\ToolOffs] [\Speed]

[\ID] **(Identifier)** Data type: *pathrecid*

Variable that specify the position to move backward to. Data type *pathrecid* is a non-value type, only used as an identifier for naming the recording position.

[\ToolOffs] *(Tool Offset)* Data type: *pos*

Provides clearance offset for TCP during motion. A cartesian offset coordinate is applied to the TCP coordinates. Positive Z offset value indicates clearance. This is useful when the robot runs a process adding material.

[\Speed] Data type: *speeddata*

Speed replaces the speed original used during forward motion. Speeddata defines the velocity for the tool centre point, the tool reorientation and the external axis. If present, this speed will be used throughout the backward movement. If omitted, the backward motion will execute with the speed in the original motion instructions.

Program execution

The path recorder is activated with the *PathRecStart* instruction. After the recorder has been started all move instructions will be recorded and the robot can be moved backwards along its recorded path at any point by executing *PathRecMoveBwd*.

Examples

```
VAR pathrecid safe_id;
CONST robtarget p0 := [...];
....
CONST robtarget p4 := [...];
VAR num choice;

MoveJ p0, vmax, z50, tool1;
PathRecStart safe_id;
MoveJ p1, vmax, z50, tool1;
MoveL p2, vmax, z50, tool1;
MoveL p3, vmax, z50, tool1;
MoveL p4, vmax, z50, tool1;

ERROR:
TPReadFK choice,"Go to safe?",stEmpty,stEmpty,stEmpty,stEmpty,"Yes";
        IF choice=5 THEN
            IF PathRecValidBwd(\ID:=safe_id) THEN
                                                    StorePath;
                                                    PathRecMoveBwd
  \ID:=safe_id \ToolOffs:=[0, 0 , 10];
                                                    Stop;
                                                    ! Fix problem
                                                    PathRecMoveFwd;
                                                    RestoPath;
                                                    StartMove;
                                                    RETRY;
            ENDIF
        ENDIF
```

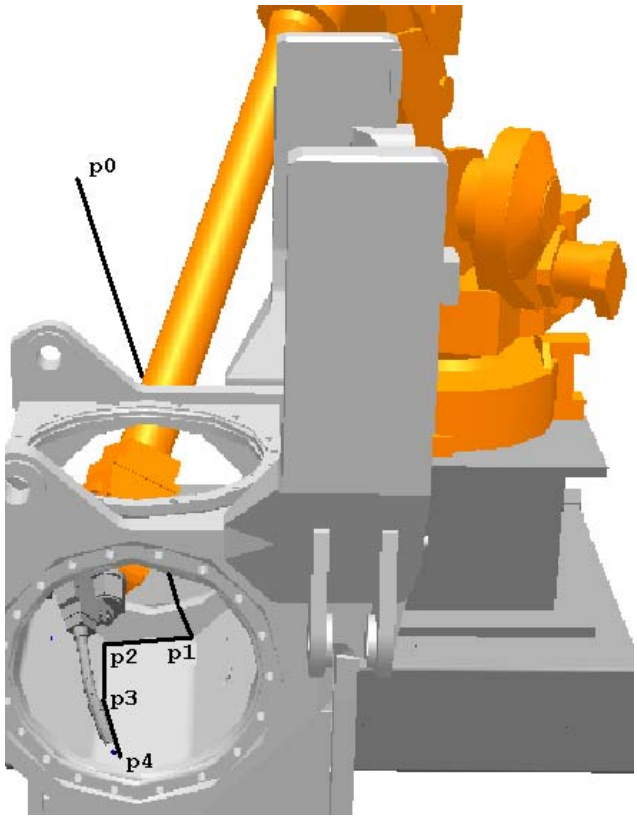


Figure 25 This example shows how the path recorder can be utilized to extract the robot from narrow spaces upon error without programming a designated path.

A part is being manufactured. At the approach point, *p0*, the path recorder is started and given the path recorder identifier *safe_id*. Assume that when the robot moves from *p3* to *p4* and recoverable error arise. At that point, the path is stored by executing *StorePath*. By storing the path the error handler can start a new movement and later on restart the original movement. When the path has been stored the path recorder is used to move the robot out to the safe position, *p0*, by executing *PathRecMoveBwd*.

Note that a tool offset is applied to provide clearance from for example a newly added weld. When the robot has been moved out the operator can do what is necessary to fix the error (for example clean the torch of welding). Then, the robot is moved back to the error location by the means of *PathRecMoveFwd*. At the error location the path level is switched back to base level by *RestoPath* and a retry attempt is made.

Limitations

- Movements using the path recorder has to be performed on trap-level, i.e. *StorePath* has to executed prior to *PathRecMoveBwd*.
- If it is not desired to return to the point where *PathRecMoveBwd* was executed (by executing *PathRecMoveFwd*) the PathRecorder has to be stopped by the means of *PathRecStop*.

Syntax

PathRecMoveBwd
[‘\’ ID ‘:=’ < variable (**VAR**) of *pathrecid* >]
[‘\’ ToolOffs ‘:=’ <expression (**IN**) of *pos*>]
[‘\’ Speed ‘:=’ <expression (**IN**) of *speeddata*>]’;’

Related information

	Described in:
Path Recorder Identifiers	Data types - pathrecid
Start - stop the path recorder	Instructions - PathRecStart, PathRecStop
Check for valid recorded path	Functions - PathRecValidBwd, PathRecValidFwd
Move path recorder forward	Instructions - PathRecMoveFwd
Store - restore paths	Instructions - StorePath , RestoPath
Other positioning instructions	RAPID Summary - Motion
Error Recovery	RAPID Summary - Error Recovery, Basic Characteristics - Error Recovery

PathRecMoveFwd - Move path recorder forward

PathRecMoveFwd is used to move the robot back to the position where *PathRecMoveBwd* was executed. It is also possible to move the robot partly forward by supplying an identifier that has been passed during the backward movement.

Example

PathRecMoveFwd;

The robot is moved back to the position where the path recorder started the backward movement.

Arguments

PathRecMoveFwd [\ID] [\ToolOffs] [\Speed]

[\ID] *(Identifier)* Data type: *pathrecid*

Variable that specify the position to move forward to. Data type *pathrecid* is a non-value type, only used as an identifier for naming the recording position.

[\ToolOffs] *(Tool Offset)* Data type: *pos*

Provides clearance offset for TCP during motion. A cartesian coordinate is applied to the TCP coordinates. This is useful when the robot runs a process adding material.

[\Speed] Data type: *speeddata*

Speed overrides the speed original used during forward motion. Speeddata defines the velocity for the tool centre point, the tool reorientation and the external axis. If present, this speed will be used throughout the forward movement. If omitted, the forward motion will execute with the speedin the original motion instructions.

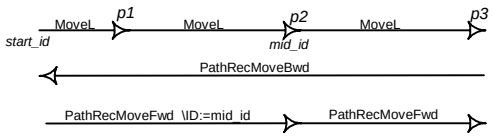
Program execution

The path recorder is activated with the *PathRecStart* instruction. After the recorder has been started the robot can be moved backwards along its executed path by executing *PathRecMoveBwd*. The robot can thereafter be ordered back to the position where the backward execution started by calling *PathRecMoveFwd*. It is also possible to move the robot partly forward by supplying an identifier that has been passed during the backward movement.

Examples

```
VAR pathrecid start_id;
VAR pathrecid mid_id;
CONST robtarget p1 := [...];
CONST robtarget p2 := [...];
CONST robtarget p3 := [...];

  PathRecStart start_id;
  MoveL p1, vmax, z50, tool1;
  MoveL p2, vmax, z50, tool1;
  PathRecStart mid_id;
  MoveL p3, vmax, z50, tool1;
  StorePath;
  PathRecMoveBwd \ID:=start_id;
  PathRecMoveFwd \ID:=mid_id;
  PathRecMoveFwd;
  RestoPath;
```



The example above will start the path recorder and the starting point will be tagged with the path identifier *start_id*. Thereafter, the robot will move forward with traditional move instructions and then move back to the path recorder identifier *start_id* using the recorded path. Finally, it will move forward again in two steps by the means of *PathRecMoveFwd*.

Limitations

- Movements using the path recorder has to be performed on trap-level, i.e. *StorePath* has to executed prior to *PathRecMoveFwd*.

- To be able to execute *PathRecMoveFwd* a *PathRecMoveBwd* must have been executed before.

Syntax

PathRecMoveFwd ’(’
  [‘\’ ID ‘:=’ < variable (**VAR**) of *pathid* >]
  [‘\’ ToolOffs ‘:=’ <expression (**IN**) of *pos*>]
  [‘\’ Speed ‘:=’ <expression (**IN**) of *speeddata*>]’;’

Related information

	Described in:
Path Recorder Identifiers	Data types - pathrecid
Start - stop the path recorder	Instructions - PathRecStart, PathRecStop
Check for valid recorded path	Functions - PathRecValidBwd, PathRecValidFwd
Move path recorder backward	Instructions - PathRecMoveBwd
Store - restore paths	Instructions - StorePath, RestoPath
Other positioning instructions	RAPID Summary - Motion
Error Recovery	RAPID Summary - Error Recovery, Basic Characteristics - Error Recovery

PathRecStart - Start the path recorder

PathRecStart is used to start recording the robot's path. The path recorder will store path information during execution of the RAPID program.

Example

```
VAR pathrecid fixture_id;

PathRecStart fixture_id;
```

The path recorder is started and the starting point (the instruction's position in the RAPID program) is tagged with the identifier *fixture_id*.

Arguments

PathRecStart ID

ID **(Identifier)** Data type: *pathrecid*

Variable that specify the name of the recording start position. Data type *pathrecid* is a non-value type, only used as an identifier for naming the recording position.

Program execution

When the path recorder is ordered to start the robot path will be recorded internally in the robot controller. The recorded sequence of program positions can be traversed backwards by means of *PathRecMoveBwd*, causing the robot to *move backwards along its executed path.*

Example

```
VAR pathrecid origin_id;
VAR pathrecid corner_id;
VAR num choice;
        MoveJ p1, vmax, z50, tool1;
        PathRecStart origin_id;
        MoveJ p2, vmax, z50, tool1;
        PathRecStart corner_id;
        MoveL p3, vmax, z50, tool1;
        MoveAbsJ jt4, vmax, fine, tool1;
```

```
ERROR
                TPReadFK choice,"Extract to:",stEmpty,stEmpty,stEmpty,"Ori-
  gin","Corner";
                IF choice=4 OR choice=5 THEN
                    StorePath;
                    IF choice=4 THEN
                                                        PathRecMoveBwd
  \ID:=origin_id;
                    ELSE
                                                        PathRecMoveBwd
  \ID:=corner_id;
                    ENDIF
                    Stop;
                    ! Fix problem
                    PathRecMoveFwd;
                    RestoPath;
                    StartMove;
                    RETRY;
                ENDIF
```

In the example above the path recorder is used for moving the robot to a service position if an error during normal execution occur.

The robot is executing along a path. After the position *p1* the path recorder is started. After the point *p2* another path identifier is inserted. Assume that a recoverable error occurs while moving from position *p3* to position *jt4*. The error handler will now be invoked and the user can choose between extracting the robot to position Origin or Corner. Then, the path level is switched with *StorePath* to be able to restart at the error location later on. When the robot has backed out from the error location it's up to the user solving the error (usually fixing the robots surrounding equipment).

Then, the robot is ordered back to the error location and the path level switched back to normal and a retry attempt is made.

Limitations

The path recorder can only be started and will only record the path in the original path level. I.e. movements at *StorePath* level are not recorded.

Syntax

PathRecStart
[ID ':='] < variable (**VAR**) of *pathrecid* > ')'

Related information

	Described in:
Path Recorder Identifiers	Data types - pathrecid
Stop the path recorder	Instructions - PathRecStop
Check for valid recorded path	Functions - PathRecValidBwd, PathRecValid-Fwd
Play the path recorder backward	Instructions - PathRecMoveBwd
Play the path recorder forward	Instructions - PathRecMoveFwd
Motion in general	Motion and I/O Principles

PathRecStop - Stop the path recorder

PathRecStop is used to stop recording the robot's path.

Example

PathRecStop \Clear;

The path recorder is stopped and the buffer of stored path information is cleared.

Arguments

PathRecStop [\Clear]

[\Clear] Data type: *switch*

Clear the recorded path.

Program execution

When the path recorder is ordered to stop, the recording of the path will stop. The optional argument *\Clear* will clear the buffer of stored path information preventing the recorded path to be executed, by mistake.

After the recorder has been stopped, earlier recorded paths cannot be used for back-up movements*(PathRecMoveBwd).* However, it is possible to use earlier recorded paths if *PathRecMoveBwd* is ordered from the same positions as the robot was stopped in.

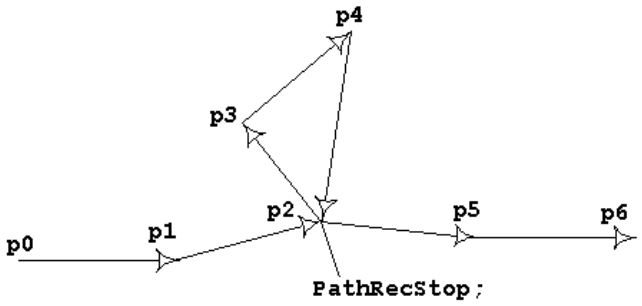
Examples

```
LOCAL VAR pathrecid id1;
LOCAL VAR pathrecid id2;
LOCAL CONST robtarget p1:= [...];
......
LOCAL CONST robtarget p6 := [...];

PROC example1()
        PathRecStart id1;
        MoveL p1, vmax, z50, tool1;
        MoveL p2, vmax, z50, tool1;
        PathRecStop;
        MoveL p3, vmax, z50, tool1;
```

```
            MoveL p4, vmax, z50, tool1;
            MoveL p2, vmax, z50, tool1;
            PathRecStart id2;
            MoveL p5, vmax, z50, tool1;
            MoveL p6, vmax, z50, tool1;
            StorePath;
            PathRecMoveBwd \ID:=id1;
            RestoPath;
ENDPROC

PROC example2()
            PathRecStart id1;
            MoveL p1, vmax, z50, tool1;
            MoveL p2, vmax, z50, tool1;
            PathRecStop;
            MoveL p3, vmax, z50, tool1;
            MoveL p4, vmax, z50, tool1;
            PathRecStart id2;
            MoveL p2, vmax, z50, tool1;
            MoveL p5, vmax, z50, tool1;
            MoveL p6, vmax, z50, tool1;
            StorePath;
            PathRecMoveBwd \ID:=id1;
            RestoPath;
ENDPROC
```



The above examples describes recording of the robot path when the recording is stopped in the middle of the sequence. In *example1* the *PathRecMoveBwd \ID:=id1;* order is valid and the robot will execute the following path: *p6 -> p5 -> p2 -> p1 -> p0*

The reason for that the order is valid is due to that the recorder was stopped and started in the exact same robot position. If this behavior isn't desirable the stop order should include the optional argument *Clear*. In that way the recorded path will be cleared and it will never be possible to back-up to previous path recorder identifiers.

The only difference in *example2* is where the recorder was started the second time. In this case *PathRecMoveBwd \ID:=id1* will cause an error. This is due to that there doesn't exist a recorded path between *p4* and *p2*. There is however possible to execute *PathRecMoveBwd \ID:=id2*.

Syntax

PathRecStop
['\'switch Clear] ';'

Related information

	Described in:
Path Recorder Identifiers	Data types - pathrecid
Start the path recorder	Instructions - PathRecStart
Check for valid recorded path	Functions - PathRecValidBwd, PathRecValidFwd
Play the recorder backward	Instructions - PathRecMoveBwd
Play the recorder forwards	Instructions - PathRecMoveFwd
Motion in general	Motion and I/O Principles

PathResol - Override path resolution

PathResol (Path Resolution) is used to override the configured geometric path sample time defined in the system parameters for the manipulator.

This instruction can only be used in the *Main* task or, if in a MultiMove System, in Motion tasks.

Description

The path resolution affects the accuracy of the interpolated path and the program cycle time. The path accuracy is improved and the cycle time is often reduced when the parameter *PathSampleTime* is decreased. A value for parameter *PathSampleTime* which is too low, may however cause CPU load problems in some demanding applications. However, use of the standard configured path resolution (*PathSampleTime* 100%) will avoid CPU load problems and provide sufficient path accuracy in most situations.

Example of *PathResol* usage:

Dynamically critical movements (max payload, high speed, combined joint motions close to the border of the work area) may cause CPU load problems. Increase the parameter *PathSampleTime*.

Low performance external axes may cause CPU load problems during coordination. Increase the parameter *PathSampleTime*.

Arc-welding with high frequency weaving may require high resolution of the interpolated path. Decrease the parameter *PathSampleTime*.

Small circles or combined small movements with direction changes can decrease the path performance quality and increase the cycle time. Decrease the parameter *PathSampleTime*.

Gluing with large reorientations and small corner zones can cause speed variations. Decrease the parameter *PathSampleTime*.

Example

```
MoveJ p1,v1000,fine,tool1;
PathResol 150;
```

With the robot at a stop point, the path sample time is increased to *150*% of the configured.

Arguments

PathResol **PathSampleTime**

PathSampleTime Data type: *num*

Override as a percent of the configured path sample time.
100% corresponds to the configured path sample time.
Within the range 25-400%.

A lower value of the parameter *PathSampleTime* improves the path resolution (path accuracy).

Program execution

The path resolutions of all subsequent positioning instructions are affected until a new *PathResol* instruction is executed. This will affect the path resolution during all program execution of movements (default path level and path level after *StorePath*) and also during jogging.

The default value for override of path sample time is 100%. This value is automatically set

- at a cold start-up
- when a new program is loaded
- when starting program execution from the beginning.

The current override of path sample time can be read from the variable *C_MOTSET* (data type *motsetdata*) in the component *pathresol*.

Syntax

PathResol
[PathSampleTime ':='] < expression (IN) of num> ';'

Related information

	Described in:
Positioning instructions	Motion and I/O Principles- Movements
Motion settings	RAPID Summary - Motion Settings
Configuration of path resolution	System Parameters - CPU Optimization

PDispOff - Deactivates program displacement

PDispOff (Program Displacement Off) is used to deactivate a program displacement.

Program displacement is activated by the instruction *PDispSet* or *PDispOn* and applies to all movements until some other program displacement is activated or until program displacement is deactivated.

This instruction can only be used in the *Main* task or, if in a MultiMove System, in Motion tasks.

Examples

```
PDispOff;
```

Deactivation of a program displacement.

```
MoveL p10, v500, z10, tool1;
PDispOn \ExeP:=p10, p11, tool1;
MoveL p20, v500, z10, tool1;
MoveL p30, v500, z10, tool1;
PDispOff;
MoveL p40, v500, z10, tool1;
```

A program displacement is defined as the difference between the positions *p10* and *p11*. This displacement affects the movement to *p20* and *p30*, but not to *p40*.

Program execution

Active program displacement is reset. This means that the program displacement coordinate system is the same as the object coordinate system, and thus all programmed positions will be related to the latter.

Syntax

PDispOff ‘;’

Related information

	Described in:
Definition of program displacemen	Instructions - PDispOn using two positions
Definition of program displacement using	Instructions - PDispSet values

PDispOn - Activates program displacement

PDispOn (Program Displacement On) is used to define and activate a program displacement using two robot positions.

Program displacement is used, for example, after a search has been carried out, or when similar motion patterns are repeated at several different places in the program.

This instruction can only be used in the *Main* task or, if in a MultiMove System, in Motion tasks.

Examples

```
MoveL p10, v500, z10, tool1;
PDispOn \ExeP:=p10, p20, tool1;
```

Activation of a program displacement (parallel movement). This is calculated based on the difference between positions *p10* and *p20*.

```
MoveL p10, v500, fine \Inpos := inpos50, tool1;
PDispOn *, tool1;
```

Activation of a program displacement (parallel movement). Since a stop point that is accurately defined has been used in the previous instruction, the argument *\ExeP* does not have to be used. The displacement is calculated on the basis of the difference between the robot's actual position and the programmed point (*) stored in the instruction.

```
PDispOn \Rot \ExeP:=p10, p20, tool1;
```

Activation of a program displacement including a rotation. This is calculated based on the difference between positions *p10* and *p20*.

Arguments

PDispOn **[\Rot] [\ExeP] ProgPoint Tool [\WObj]**

[\Rot] *(Rotation)* Data type: *switch*

The difference in the tool orientation is taken into consideration and this involves a rotation of the program.

[\ExeP] *(Executed Point)* Data type: *robtarget*

The new robot position, used for calculation of the displacement.
If this argument is omitted, the robot's current position at the time of the program execution is used.

ProgPoint *(Programmed Point)* Data type: *robtarget*

The robot's original position at the time of programming.

Tool Data type: *tooldata*

The tool used during programming, i.e. the TCP to which the *ProgPoint* position is related.

[\WObj] *(Work Object)* Data type: *wobjdata*

The work object (coordinate system) to which the *ProgPoint* position is related.

This argument can be omitted and, if it is, the position is related to the world coordinate system. However, if a stationary TCP or coordinated external axes are used, this argument must be specified.

The arguments **Tool** and **\WObj** are used both to calculate the *ProgPoint* during programming and to calculate the current position during program execution if no ExeP argument is programmed.

Program execution

Program displacement means that the ProgDisp coordinate system is translated in relation to the object coordinate system. Since all positions are related to the ProgDisp coordinate system, all programmed positions will also be displaced. See Figure 26.

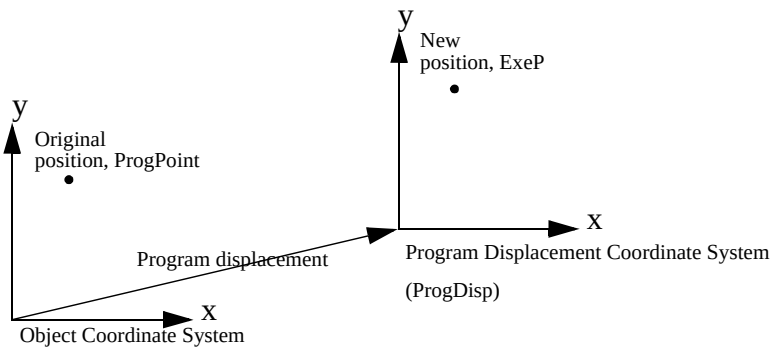


Figure 26 Displacement of a programmed position using program displacement.

Program displacement is activated when the instruction *PDispOn* is executed and remains active until some other program displacement is activated (the instruction *PDispSet* or *PDispOn*) or until program displacement is deactivated (the instruction *PDispOff*).

Only one program displacement can be active at any one time. Several *PDispOn* instructions, on the other hand, can be programmed one after the other and, in this case, the different program displacements will be added.

Program displacement is calculated as the difference between *ExeP* and *ProgPoint*. If *ExeP* has not been specified, the current position of the robot at the time of the program

execution is used instead. Since it is the actual position of the robot that is used, the robot should not move when *PDispOn* is executed.

If the argument *\Rot* is used, the rotation is also calculated based on the tool orientation at the two positions. The displacement will be calculated in such a way that the new position (*ExeP)* will have the same position and orientation in relation to the displaced coordinate system, ProgDisp, as the old position (*ProgPoint*) had in relation to the original coordinate system (see Figure 27).

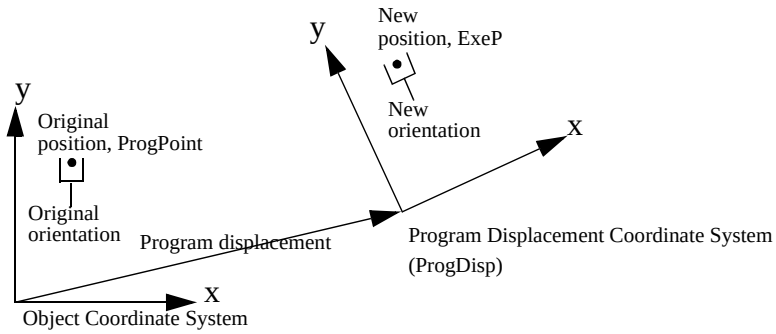


Figure 27 Translation and rotation of a programmed position.

The program displacement is automatically reset

- at a cold start-up
- when a new program is loaded
- when starting program executing from the beginning.

Example

```
PROC draw_square()
   PDispOn *, tool1;
   MoveL *, v500, z10, tool1;
   MoveL *, v500, z10, tool1;
   MoveL *, v500, z10, tool1;
   MoveL *, v500, z10, tool1;
   PDispOff;
ENDPROC
.
MoveL p10, v500, fine \Inpos := inpos50, tool1;
draw_square;
MoveL p20, v500, fine \Inpos := inpos50, tool1;
draw_square;
MoveL p30, v500, fine \Inpos := inpos50, tool1;
draw_square;
```

The routine *draw_square* is used to execute the same motion pattern at three different positions, based on the positions *p10, p20* and *p30*. See Figure 28.

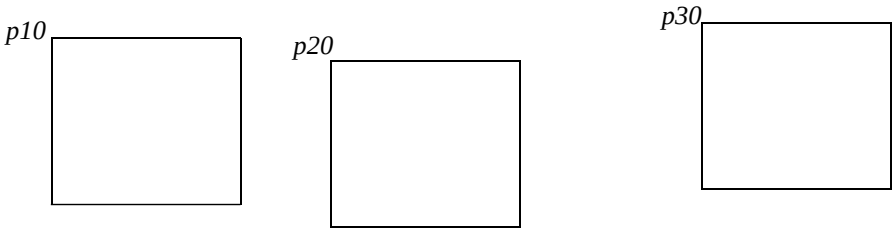


Figure 28 Using program displacement, motion patterns can be reused.

```
SearchL sen1, psearch, p10, v100, tool1\WObj:=fixture1;
PDispOn \ExeP:=psearch, *, tool1 \WObj:=fixture1;
```

A search is carried out in which the robot's searched position is stored in the position *psearch*. Any movement carried out after this starts from this position using a program displacement (parallel movement). The latter is calculated based on the difference between the searched position and the programmed point (*) stored in the instruction. All positions are based on the *fixture1* object coordinate system.

Syntax

PDispOn
[['\' Rot]
['\' ExeP ':=' < **expression (IN) of** *robtarget* **>] ',']**
[ProgPoint ':='] < **expression (IN) of** *robtarget* **> ','**
[Tool ':='] < **persistent (PERS) of** *tooldata***>**
['\'WObj ':=' < **persistent (PERS) of** *wobjdata***>] ';'**

Related information

	Described in:
Deactivation of program displacement	Instructions - PDispOff
Definition of program displacement using	Instructions - PDispSet values
Coordinate systems	Motion Principles - Coordinate Systems
Definition of tools	Data Types - tooldata
Definition of work objects	Data Types - wobjdata
More examples	Instructions - PDispOff

PDispSet - Activates program displacement using a value

PDispSet (Program Displacement Set) is used to define and activate a program displacement using values.

Program displacement is used, for example, when similar motion patterns are repeated at several different places in the program.

This instruction can only be used in the *Main* task or, if in a MultiMove System, in Motion tasks.

Example

```
VAR pose xp100 := [ [100, 0, 0], [1, 0, 0, 0] ];
.
PDispSet xp100;
```

Activation of the *xp100* program displacement, meaning that:

- The ProgDisp coordinate system is displaced 100 mm from the object coordinate system, in the direction of the positive x-axis (see Figure 29).
- As long as this program displacement is active, all positions will be displaced 100 mm in the direction of the x-axis.

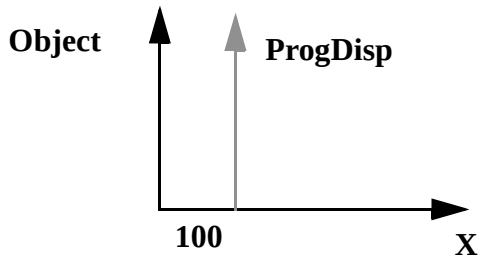


Figure 29 A 100 mm-program displacement along the x-axis.

Arguments

PDispSet **DispFrame**

DispFrame *(Displacement Frame)* Datatyp: *pose*

The program displacement is defined as data of the type *pose*.

Program execution

Program displacement involves translating and/or rotating the ProgDisp coordinate system relative to the object coordinate system. Since all positions are related to the ProgDisp coordinate system, all programmed positions will also be displaced.
See Figure 30.

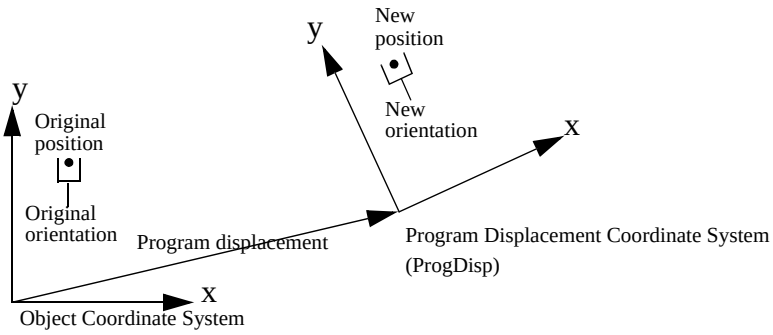


Figure 30 Translation and rotation of a programmed position.

Program displacement is activated when the instruction *PDispSet* is executed and remains active until some other program displacement is activated (the instruction *PDispSet* or *PDispOn*) or until program displacement is deactivated (the instruction *PDispOff*).

Only one program displacement can be active at any one time. Program displacements cannot be added to one another using *PDispSet*.

The program displacement is automatically reset

- at a cold start-up
- when a new program is loaded
- when starting program executing from the beginning.

Syntax

PDispSet
[DispFrame ':='] < expression (IN) of *pose*> **';'**

Related information

	Described in:
Deactivation of program displacement	Instructions - PDispOff
Definition of program displacement	Instructions - PDispOn using two positions
Definition of data of the type pose	Data Types - pose
Coordinate systems	Motion Principles- Coordinate Systems
Examples of how program displacement	Instructions - PDispOn can be used

ProcerrRecovery - Generate and recover from process-move error

ProcerrRecovery can be used to generate process error during robot movement and get the possibility to handle the error and restart the process and the movement from an ERROR handler.

Example

The examples below are not realistic, but shown for pedagogic reason.

```
MoveL p1, v50, z30, tool2;
ProcerrRecovery \SyncOrgMoveInst;
MoveL p2, v50, z30, tool2;
ERROR
   IF ERRNO = ERR_PATH_STOP THEN
      StartMove;
      RETRY;
   ENDIF
```

The robot movement is stop on it's way to *p1* and the program execution is transfer to the ERROR handler in the routine **that created the actual path on which the error occurred**, in this case the path to *MoveL p1*. The movement is restarted with *StartMove* and the execution is continued with RETRY.

```
MoveL p1, v50, fine, tool2;
ProcerrRecovery \SyncLastMoveInst;
MoveL p2, v50, z30, tool2;
ERROR
   IF ERRNO = ERR_PATH_STOP THEN
      StartMove;
      RETRY;
   ENDIF
```

The robot movement is stop at once on it's way to *p2* and the program execution is transfer to the ERROR handler in the routine **where the program currently is executing or are going to execute a move instruction when the error occurred**, in this case *MoveL p2*. The movement is restarted with *StartMove* and the execution is continued with RETRY.

Arguments

ProcerrRecovery [\SyncOrgMoveInst] | [\SyncLastMoveInst]

[\SyncOrgMoveInst] Data type: *switch*

The error can be handled in the routine that created the actual path on which the error occurred.

[\SyncLastMoveInst] Data type: *switch*

The error can be handled in the routine where the program currently is executing a move instruction when the error occurred.

If the program currently is not executing a move instruction when the error occurred, the transfer of the execution to the ERROR handler will be delayed until the program execute next move instruction. The error can be handled in that routine.

Program execution

Execution of *ProcerrRecovery* in continuous mode results in following

- *At once stop of the robot movement without leaving the path*
- Set the variable ERRNO to ERR_PATH_STOP
- Transfer the execution to some ERROR handler, according the rules for asynchronously raised errors

This instruction doe’s nothing in any step mode.

For description of asynchronously raised errors such as generated with *ProcerrRecovery* see *RAPID kernel reference/Error recovery/Asynchronously raised errors.*

ProcerrRecovery can also be used in MultiMove system, to transfer the execution to the ERROR handler in several program tasks, if running in synchronized mode.

Example with ProcerrRecovery \SyncOrgMoveInst

```
MODULE user_module
  VAR intnum proc_sup_int;

  PROC main()
    ...
    MoveL p1, v1000, fine, tool1;
    do_process;
    ...
  ENDPROC
```

```
    PROC do_process()
    my_proc_on;
    MoveL p2, v200, z10, tool1;
    MoveL p3, v200, fine, tool1;
    my_proc_off;
  ERROR
    IF ERRNO = ERR_PATH_STOP THEN
      my_proc_on;
      StartMove;
      RETRY;
    ENDIF
  ENDPROC

  TRAP iprocfail
    my_proc_off;
    ProcerrRecovery \SyncOrgMoveInst;
  ENDTRAP

  PROC my_proc_on()
    SetDO do_myproc, 1;
    CONNECT proc_sup_int WITH iprocfail;
    ISignalDI di_proc_sup, 1, proc_sup_int;
  ENDPROC

  PROC my_proc_off()
    SetDO do_myproc, 0;
    IDelete proc_sup_int;
  ENDPROC
ENDMODULE
```

Asynchronously raised errors generated by *ProcerrRecovery* with switch *\SyncOrgMoveInst* can in this example be treated in the routine *do_process*, because the path on which the error occurred is always created in the routine *do_process*.

A process flow is started by setting the signal *do_myproc* to 1. The signal *di_proc_sup* supervise the process, and an asynchronous error is raised if *di_proc_sup* becomes 1. In this simple example, the error is resolved by setting *do_myproc* to 1 again before resuming the movement.

Example with ProcerrRecovery \SyncLastMoveInst

```
MODULE user_module

    PROC main()
        ...
        MoveL p1, v1000, fine, tool1;
        do_process;
        ...
    ENDPROC
    PROC do_process()
        proc_on;
        proc_move p2, v200, z10, tool1;
        proc_move p3, v200, fine, tool1;
        proc_off;
    ERROR
        IF ERRNO = ERR_PATH_STOP THEN
            StorePath;
            p4 := CRobT(\Tool:=tool1);
            ! Move to service station and fix the problem
            MoveL p4, v200, fine, tool1;
            RestoPath;
            proc_on;
            StartMoveRetry;
        ENDIF
    ENDPROC
ENDMODULE

MODULE proc_module (SYSMODULE, NOSTEPIN)
    VAR intnum proc_sup_int;
    VAR num try_no := 0;

TRAP iprocfail
        proc_off;
        ProcerrRecovery \SyncLastMoveInst;
    ENDTRAP

    PROC proc_on()
        SetDO do_proc, 1;
        CONNECT proc_sup_int WITH iprocfail;
        ISignalDI di_proc_sup, 1, proc_sup_int;
    ENDPROC

    PROC proc_off()
        SetDO do_proc, 0;
        IDelete proc_sup_int;
    ENDPROC
```

```
PROC proc_move (robtarget ToPoint, speeddata Speed, zonedata Zone,
   PERS tooldata Tool)
   MoveL ToPoint, Speed, Zone, Tool;
   ERROR
      IF ERRNO = ERR_PATH_STOP THEN
         try_no := try_no + 1;
         IF try_no < 4THEN
            proc_on;
            StartMoveRetry;
         ELSE
            RaiseToUser \Continue;
         ENDIF
   ENDPROC
ENDMODULE
```

Asynchronously raised errors generated by *ProcerrRecovery* with switch *\SyncLastMoveInst* can in this example be treated in the routine *proc_move*, because all move instructions are always created in the routine *proc_move*. When program pointer is in routine *do_process*, the transfer to ERROR handler will be delayed until running next *MoveL* in routine *proc_move*. Note that the movements are always stopped at once.

A process flow is started by setting the signal *do_myproc* to 1. The signal *di_proc_sup* supervise the process, and an asynchronous error is raised if *di_proc_sup* becomes 1. In this simple example, the error is resolved by setting *do_myproc* to 1 again before resuming the movement.

When using predefined NOSTEPIN routine, we recommended to use the option switch parameter *\SyncLastMoveInst*, because then the predefined routine can take the decision to handle some error situation within the routine, while other must be handle by the end user.

Limitations

See *RAPID kernel reference/Error recovery/Asynchronously raised errors.*

Syntax

```
ProcerrRecovery
   ['\'SyncOrgMoveInst]
   | ['\'SyncLastMoveInst] ';'
```

Related information

	Described in:
Error handlers	Basic Characteristics - Error Recovery
Asynchronously raised errors	RAPID kernel reference - Error recover
Propagates an error to user level	Instruction - RaiseToUser
Resume movement and program	Instruction - StartMoveRetry execution

ProcCall - Calls a new procedure

A procedure call is used to transfer program execution to another procedure. When the procedure has been fully executed, program execution continues with the instruction following the procedure call.

It is usually possible to send a number of arguments to the new procedure. These control the behaviour of the procedure and make it possible for the same procedure to be used for different things.

Examples

```
weldpipe1;
```

Calls the *weldpipe1* procedure.

```
errormessage;
Set do1;
   .

PROC errormessage()
   TPWrite "ERROR";
ENDPROC
```

The *errormessage* procedure is called. When this procedure is ready, program execution returns to the instruction following the procedure call, *Set do1*.

Arguments

Procedure { Argument }

Procedure Identifier

The name of the procedure to be called.

Argument Data type: In accordance with the procedure declaration

The procedure arguments (in accordance with the parameters of the procedure).

Example

```
weldpipe2 10, lowspeed;
```

Calls the *weldpipe2* procedure, including two arguments.

```
weldpipe3 10 \speed:=20;
```

Calls the *weldpipe3* procedure, including one mandatory and one optional argument.

Limitations

The procedure's arguments must agree with its parameters:

- All mandatory arguments must be included.
- They must be placed in the same order.
- They must be of the same data type.
- They must be of the correct type with respect to the access-mode (input, variable or persistent).

A routine can call a routine which, in turn, calls another routine, etc. A routine can also call itself, i.e. a recursive call. The number of routine levels permitted depends on the number of parameters, but more than 10 levels are usually permitted.

Syntax

(EBNF)
<procedure> [<argument list>] ';'

<procedure> ::= <identifier>

Related information

	Described in:
Arguments, parameters	Basic Characteristics - Routines
More examples	Program Examples

PulseDO - Generates a pulse on a digital output signal

PulseDO is used to generate a pulse on a digital output signal.

Examples

PulseDO do15;

A pulse with a pulse length of *0.2* s is generated on the output signal *do15*.

PulseDO \PLength:=1.0, ignition;

A pulse of length *1.0* s is generated on the signal *ignition*.

```
! Program task MAIN
PulseDO \High, do3;
! At almost the same time in program task BCK1
PulseDO \High, do3;
```

Positive pulse (value 1) is generated on the signal *do3* from two program tasks at almost the same time. It will result in one positive pulse with a pulse length longer than the default 0.2 s or two positive pulses after each other with a pulse length of 0.2 s.

Arguments

PulseDO [\High] [\PLength] Signal

[\High] *(High level)* Data type: *switch*

Specifies that the signal value should always be set to high (value 1) when the instruction is executed, independently of its current state.

[\PLength] *(Pulse Length)* Data type: *num*

The length of the pulse in seconds (0.1 - 32s).
If the argument is omitted, a 0.2 second pulse is generated.

Signal Data type: *signaldo*

The name of the signal on which a pulse is to be generated.

Program execution

A pulse is generated with a specified pulse length (see Figure 31).

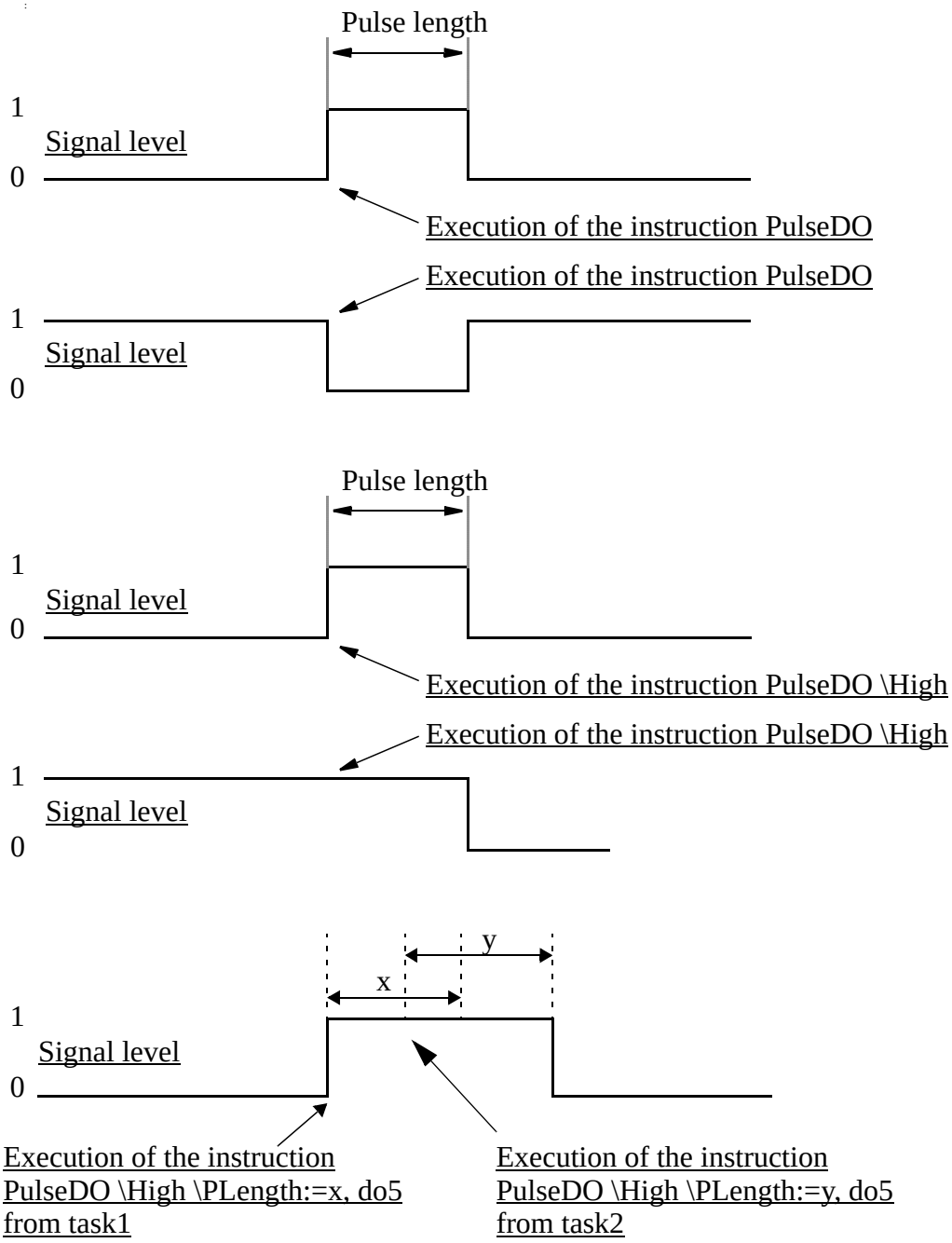


Figure 31 Generation of a pulse on a digital output signal.

The next instruction is executed directly after the pulse starts. The pulse can then be set/reset without affecting the rest of the program execution.

Limitations

The length of the pulse has a resolution of 0.01 seconds. Programmed values that differ from this are rounded off.

Error handling

Following recoverable error can be generated. The error can be handled in an error handler. The system variable ERRNO will be set to:

ERR_NORUNUNIT	if there is no contact with the unit

Syntax

PulseDO
[[’\’High]
[’\’PLength ’:=’ < expression (**IN**) of *num* >] ‘,’]
[Signal ’:=’] < variable (**VAR**) of *signaldo* > ’;’

Related information

	Described in:
Input/Output instructions	RAPID Summary - Input and Output Signals
Input/Output functionality in general	Motion and I/O Principles - I/O Principles
Configuration of I/O	System Parameters

RAISE - Calls an error handler

RAISE is used to create an error in the program and then to call the error handler of the routine. *RAISE* can also be used in the error handler to propagate the current error to the error handler of the calling routine.

This instruction can, for example, be used to jump back to a higher level in the structure of the program, e.g. to the error handler in the main routine, if an error occurs at a lower level.

Example

```
IF ...
   IF ...
      IF ...
         RAISE escape1;
   .
ERROR
   IF ERRNO=escape1 RAISE;
```

The routine is interrupted to enable it to remove itself from a low level in the program. A jump occurs to the error handler of the called routine.

Arguments

RAISE [Error no.]

Error no. Data type: *errnum*

Error number: Any number between 1 and 90 which the error handler can use to locate the error that has occurred (the *ERRNO* system variable).

It is also possible to book an error number outside the range 1-90 with the instruction *BookErrNo*.

The error number must be specified outside the error handler in a RAISE instruction in order to be able to transfer execution to the error handler of that routine.

If the instruction is present in a routine's error handler, the error number may not be specified. In this case, the error is propagated to the error handler of the calling routine.

Program execution

Program execution continues in the routine’s error handler. After the error handler has been executed, program execution can continue with:

- the routine that called the routine in question (RETURN),
- the error handler of the routine that called the routine in question (RAISE).

If the RAISE instruction is present in a routine’s error handler, program execution continues in the error handler of the routine that called the routine in question. The same error number remains active. A RAISE instruction in a routine’s error handler has also another feature, it can be used for long jump (see “Error Recovery With Long Jump”). With a long jump it is possible to propagate an error from an error handler from a deep neested call chain to a higher level in one step.

If the RAISE instruction is present in a trap routine, the error is dealt with by the system’s error handler.

Error handling

If the error number is out of range, the system variable ERRNO is set to ERR_ILLRAISE (see "Data types - errnum"). This error can be handled in the error handler.

Syntax

(EBNF)
RAISE [<error number>] ’;’

<error number> ::= <expression>

Related information

	Described in:
Error handling	Basic Characteristics - Error Recovery
Error recovery with long jump	Basic Characteristics - Error Recovery
Booking error numbers	Instructions - BookErrNo

RaiseToUser - Propagates an error to user level

RaiseToUser is used in an error handler in nostepin routines to propagate the current error or any other defined error to the error handler at user level. User level is in this case the first routine, in a call chain, above a nostepin routine.

Example

Example of instruction *RaiseToUser*:

```
MODULE MyModule
        PROC main()
            VAR errnum ERR_MYDIVZERO:= -1;
            BookErrNo ERR_MYDIVZERO;
            ......
            routine1;
            ......
            ERROR
            IF ERRNO = ERR_MYDIVZERO THEN
                TRYNEXT;
            ELSE
                RETRY;
            ENDIF
        ENDPROC
ENDMODULE

MODULE MySysModule (SYSMODULE, NOSTEPIN, VIEWONLY)
        PROC routine1()
            ......
            routine2;
            ......
        UNDO
        ! Free allocated resources
        ENDPROC
```

```
        PROC routine2()
            VAR num n:=0;
            .....
            reg1:=reg2/n;
            .....
            ERROR
            IF ERRNO = ERR_DIVZERO THEN
                RaiseToUser \Continue \ErrorNumber:=ERR_MYDIVZERO;
            ELSE
                RaiseToUser \BreakOff;
            ENDIF
        ENDPROC
ENDMODULE
```

The division by zero in *routine2* will propagate up to the error handler in main routine with the errno set to ERR_MYDIVZERO. The TRYNEXT instruction in main error handler will then cause the program execution to continue at the instruction after the division by zero in *routine2*. The *\Continue* switch controls this behavior.

If any other errors occur in *routine2* the *\BreakOff* switch force the execution to continue from the error handler in *main* routine. In this case the undo handler in *routine1* will be executed while raising to user level. The RETRY instruction in the error handler in main routine will execute *routine1* from the beginning ones again.

The undo handler in *routine1* will also be executed in the *\Continue* case if a following RAISE or RETURN is done on the user level.

Arguments

RaiseToUser [\Continue] | [\BreakOff] [\ErrorNumber]

[\Continue] Data type: *switch*

Continue the execution in the routine that caused the error.

[\BreakOff] Data type: *switch*

Break off the call chain and continue execution at the user level. Any undo handler in the call chain will be executed apart from the undo handler in the routine that raised the error.

One of argument *\Continue* or *\BreakOff* must be programmed.

[\ErrorNumber] Data type: *errnum*

Any number between 1 and 90 that the error handler can use to locate the error that has occurred (the *ERRNO* system variable).

It is also possible to book an error number outside the range 1-90 with the instruction *BookErrNo*.

The error is propagated to the error handler in the routine at user level if *\ErrorNumber* is not specified.

Program execution

RaiseToUser can only be used in an error handler in a nostepin routine.

Program execution continues in the error handler of the routine at user level. The same error number remains active if the optional parameter *\ErrorNumber* is not present. The system's error handler deals with the error if there is no error handler on user level.

There are two different behaviors after the error handler has been executed. The program execution continues in the routine with *RaiseToUser* if the *\Continue* switch is on. The program execution continues at the user level if the *\BreakOff* switch is on. The system's error handler is called if none of the argument *\Continue* or *\BreakOff* is specified

Program execution can continue with:

- the instruction that cause the error (RETRY)
- the following instruction (TRYNEXT)
- the error handler of the routine that called the routine at user level (RAISE)
- the routine that called the routine at user level (RETURN)

Error handling

If the error number is out of range, the system variable ERRNO is set to ERR_ILLRERAISE (see "Data types - errnum"). The system's error handler deals with this error.

Syntax

RaiseToUser
['\'Continue]
'|' ['\'BreakOff]
['\'ErrorNumber ':='] < expression (**IN**) of *errnum*> ';'

Related information

	Described in:
Error handling	Basic Characteristics - Error Recovery
Undo handling	Basic Characteristics - UNDO
Booking error numbers	Instructions - BookErrNo

ReadAnyBin - Read data from a binary serial channel or file

ReadAnyBin (Read Any Binary) is used to read any type of data from a binary serial channel or file.

Example

```
VAR iodev channel2;
VAR robtarget next_target;
...
Open "com2:", channel2 \Bin;
ReadAnyBin channel2, next_target;
```

The next robot target to be executed, next_target, is read from the channel referred to by *channel2*.

Arguments

ReadAnyBin IODevice Data [\Time])

IODevice Data type: *iodev*

The name (reference) of the binary serial channel or file to be read.

Data Data type: *ANYTYPE*

The VAR or PERS to which the read data will be stored.

[\Time] Data type: *num*

The max. time for the reading operation (timeout) in seconds. If this argument is not specified, the max. time is set to 60 seconds.

If this time runs out before the read operation is finished, the error handler will be called with the error code ERR_DEV_MAXTIME. If there is no error handler, the execution will be stopped.

The timeout function is in use also during program stop and will be noticed in the RAPID program at program start.

Program execution

As many bytes as required for the specified data are read from the specified binary serial channel or file.

Limitations

This instruction can only be used for serial channels or files that have been opened for binary reading.

The data to be read by this instruction must have a *value* data type of *atomic*, *string*, or *record* data type. *Semi-value* and *non-value* data types cannot be used.

Array data cannot be used.

Note that the VAR or PERS variable, for storage of the data read, can be updated in several steps. Therefore, always wait until the whole data structure is updated before using read data from a TRAP or another program task.

Error handling

If an error occurs during reading, the system variable ERRNO is set to ERR_FILEACC.

If timeout before the read operation is finished, the system variable ERRNO is set to ERR_DEV_MAXTIME.

If there is a checksum error in the data read, the system variable ERRNO is set to ERR_RANYBIN_CHK.

If the end of the file is detected before all the bytes are read, the system variable ERRNO is set to ERR_RANYBIN_EOF.

These errors can then be dealt with by the error handler.

Example

```
CONST num NEW_ROBT:=12;
CONST num NEW_WOBJ:=20;
VAR iodev channel;
VAR num input;
VAR robtarget cur_robt;
VAR wobjdata cur_wobj;

Open "com2:", channel\Bin;

! Wait for the opcode character
input := ReadBin (channel \Time:= 0.1);
TEST input
CASE NEW_ROBT:
   ReadAnyBin channel, cur_robt;
CASE NEW_WOBJ:
   ReadAnyBin channel, cur_wobj;
ENDTEST

Close channel;
```

As a first step, the opcode of the message is read from the serial channel. According to this opcode a robtarget or a wobjdata is read from the serial channel.

Syntax

ReadAnyBin
[IODevice':='] <variable (**VAR**) of *iodev*>','
[Data':='] <var or pers (**INOUT**) of *ANYTYPE*>
['\'Time':=' <expression (**IN**) of *num*>]';'

Related information

	Described in:
Opening (etc.) of serial channels	RAPID Summary - Communication or files
Write data to a binary serial channel	Instructions - WriteAnyBin or file

ReadBlock - read a block of data from device

ReadBlock (Write Block) is used to read a block of data from a device connected to the serial sensor interface. *The data is stored in a file on ramdisk or floppy disk.*

The sensor interface communicates with a maximum of two sensors over serial channels using the RTP1 transport protocol.
The two channels must be named “laser1:” and “swg:”.

This is an example of a sensor channel configuration.

```
COM_PHY_CHANN:
                    -name “sio1:” -type “sio”-Channel 1-Baudrate 19200
COM_TRP:
                    -Name “laser1:”-Type “RTP1” -PhyChnnel “sio1”
```

Example

```
CONST string SensorPar := “flp1:senpar.cfg”;
CONST num ParBlock:= 1;


! Read sensor parameters from sensor datablock 1
! and store on flp1:senpar.cfg

ReadBlock ParBlock, SensorPar;
```

Arguments

ReadBlock BlockNo FileName [\SensorNo]

BlockNo Data type: *num*

The argument *BlockNo* is used to select the data block in the sensor to be read.

FileName Data type: *string*

The argument *FileName* is used to define a file to which data is written from the data block in the sensor selected by the *BlockNo* argument.

[\SensorNo] Data type: *num*

The optional SensorNo is used if more than one sensor is connected to the robot controller.
SensorNo 0 selects the sensor connected to the “laser1:” channel.
SensorNo 1 selects the sensor connected to the “swg:” channel.

If the argument is left out the default SensorNo 0 is used.

Fault management

Error constant (*ERRNO* value)	Description
SEN_NO_MEAS	Measurement failure
SEN_NOREADY	Sensor unable to handle command
SEN_GENERRO	General sensor error
SEN_BUSY	Sensor busy
SEN_UNKNOWN	Unknown sensor
SEN_EXALARM	External sensor error
SEN_CAALARM	Internal sensor error
SEN_TEMP	Sensor temperature error
SEN_VALUE	Illegal communication value
SEN_CAMCHECK	Sensor check failure
SEN_TIMEOUT	Communication error

Syntax

```
ReadBlock
   [ BlockNo ':=' ] < expression (IN) of num >
   [ FileName ':=' ] < expression (IN) of string >
                [ ( '\' SensorNo ':=' < expression (IN) of num > ) ] ';'
```

Related information

	Described in:
Write a sensor variable	Instructions - WriteVar
Read a sensor variable	Functions - ReadVar
Write a sensor data block	Instructions - WriteBlock
Configuration of	System Parameters - Communication sensor communication

ReadCfgData - Reads attribute of a system parameter

ReadCfgData is used to read one attribute of a named system parameter (configuration data).

Examples

ReadCfgData “/MOC/MOTOR_CALIB/ROB_1”,”cal_offset”,offset1;

Reads the value of the calibration offset for axis ROB_1 into the num variable *offset1*.

ReadCfgData “/EIO/EIO_SIGNAL/process_error”,”Unit”,io_unit;

Reads the name of the I/O unit where the signal *process_error* is defined, into the string variable *io_unit*.

Arguments

ReadCfgData InstancePath Attribute CfgData

InstancePath Data type: *string*

Specifies a path to the named parameter to be accessed. The format of this string is /DOMAIN/TYPE/InstanceName

Attribute Data type: *string*

The name of the attribute of the parameter to be read.

CfgData Data type: *any type*

The variable where the attribute will be stored. Depending on the attribute type, the valid types are bool, num, or string.

Program execution

The value of the attribute specified by the *Attribute* argument is stored in the variable specified by the *CfgData* argument.

Limitations

The conversion from system parameter units (m, radian, second etc.) to RAPID program units (mm, degree, second etc.) for *CfgData* of data type *num* must be done by the user in the RAPID program.

Only named parameters can be accessed, i.e. parameters where the first attribute is ‘name’, ‘Name’, or ‘NAME’.

RAPID strings are limited to 80 characters. In some cases, this can be in theory too small for the definition *InstancePath*, *Attribute*, or *CfgData*.

Error handling

If it is not possible to find the data specified with “*InstancePath + Attribute*” in the configuration database, the system variable ERRNO is set to ERR_CFG_NOTFND.

If the data type for parameter *CfgData* is not equal to the real data type for the found data specified with “*InstancePath + Attribute*” in the configuration database, the system variable ERRNO is set to ERR_CFG_ILLTYPE.

If trying to read internal data, the system variable ERRNO is set to ERR_CFG_INTERNAL.

These errors can then be handled in the error handler.

Syntax

ReadCfgData
[InstancePath ’:=’] < expression (**IN**) of *string* >’,’
[Attribute ’:=’] < expression (**IN**) of *string* > ’,’
[CfgData ’:=’] < variable (**VAR**) of *anytype* > ’;’

Related information

	Described in:
Definition of string	Data types- string
Write attribute of a system parameter	Instructions - WriteCfgData
Get robot name in current task	Function - RobName
Configuration	System Parameters

ReadErrData - Gets information about an error

ReadErrData is to be used in a trap routine, to get information (domain, type, number and intermixed strings %s) about an error, a state change, or a warning, that caused the trap routine to be executed.

Refer to *User Guide - Error Management, System and Error Messages* for more information.

Example

```
VAR errdomain err_domain;
VAR num err_number;
VAR errtype err_type;
VAR trapdata err_data;
VAR string string1;
VAR string string2;
...
TRAP trap_err
   GetTrapData err_data;
   ReadErrData err_data, err_domain, err_number,
   err_type \Str1:=string1 \Str2:=string2;
ENDTRAP
```

When an error is trapped to the trap routine *trap_err*, the error domain, the error number, the error type and the two first intermixed strings in the error message are saved into appropriate variables.

Arguments

ReadErrData TrapEvent ErrorDomain ErrorId ErrorType [\Str1] [\Str2] [\Str3] [\Str4] [\Str5]

TrapEvent Data type: *trapdata*

Variable containing the information about what caused the trap to be executed.

ErrorDomain Data type: *errdomain*

The error domain to which the error, state change, or warning that occurred belongs. Ref. to predefined data of type *errdomain*.

ErrorId Data type: *num*

The number of the error that occurred.
The error number is returned without the first digit (error domain) and without the initial zeros of the complete error number.

E.g. 10008 Program restarted, is returned as 8.

ErrorType Data type: *errtype*

The type of event such as error, state change, or warning that occurred. Ref. to predefined data of type *errtype*.

[\Str1] ... [\Str5] Data type: *string*

The string holding information that is intermixed into the error message. There could be up to five strings in a message. *Str1* holds the first string, *Str2* holds the second string and so on. Information about how many strings there are in a message is found in *User Guide - Error Management, System and Error Messages.* The intermixed string are maked as %s, %d or %f in that document.

Program execution

The *ErrorDomain, ErrorId, ErrorType and Str1 ... Str5* variables are updated according to the contents of *TrapEvent*.

If different events are connected to the same trap routine, the program must make sure that the event is related to error monitoring. This can be done by testing that INTNO matches the interrupt number used in the instruction *IError*;

Example

```
VAR intnum err_interrupt;
VAR trapdata err_data;
VAR errdomain err_domain;
VAR num err_number;
VAR errtype err_type;
...
CONNECT err_interrupt WITH trap_err;
IError COMMON_ERR, TYPE_ERR, err_interupt;
...
IDelete err_interrupt;
...
TRAP trap_err
   GetTrapData err_data;
   ReadErrData err_data, err_domain, err_number, err_type;
   ! Set domain no 1 ... 13
   SetGO go_err1, err_domain;
   ! Set error no 1 ...9999
   SetGO go_err2, err_number;
ENDTRAP
```

When an error occurs (only errors, not warning or state change), the error number is retrieved in the trap routine and its value is used to set 2 groups of digital outputs.

Limitation

It is not possible obtain information about internal errors.

Syntax

ReadErrData
[TrapEvent ':='] <variable (**VAR**) of *trapdata*>','
[ErrorDomain ':='] <variable (**VAR**) of *errdomain*>','
[ErrorId':='] <variable (**VAR**) of *num*>','
[ErrorType ':='] <variable (**VAR**) of *errtype*>
['\'Str1 ':='<variable (**VAR**) of *string*>]
['\'Str2 ':='<variable (**VAR**) of *string*>]
['\'Str3 ':='<variable (**VAR**) of *string*>]
['\'Str4 ':='<variable (**VAR**) of *string*>]
['\'Str5 ':='<variable (**VAR**) of *string*>]';'

Related information

	Described in:
Summary of interrupts	RAPID Summary - Interrupts
More information on interrupt management	Basic Characteristics- Interrupts
Error domains, predefined constants	Data Types - errdomain
Error types, predefined constants	Data Types - errtype
Orders an interrupt on errors	Instructions - IError
Get interrupt data for current TRAP	Instructions - GetTrapData

ReadRawBytes - Read rawbytes data

ReadRawBytes is used to read data of type rawbytes from a device opened with Open\Bin.

Example

```
VAR iodev io_device;
VAR rawbytes raw_data_out;
VAR rawbytes raw_data_in;
VAR num float := 0.2;
VAR string answer;

ClearRawBytes raw_data_out;
PackDNHeader “10”, "20 1D 24 01 30 64", raw_data;
PackRawBytes float, raw_data_out, (RawBytesLen(raw_data_out)+1) \Float4;

Open “dsqc328_1”, io_device \Bin;
WriteRawBytes io_device, raw_data_out;
ReadRawBytes io_device, raw_data_in \Time:=1;
Close io_device;

UnpackRawBytes raw_data_in, 1, answer \ASCII:=10;
```

In this example *raw_data_out* is cleared, and then packed with DeviceNet header and a float with value *0.2*.

A device, “*dsqc328_1:*”, is opened and the current valid data in *raw_data_out* is written to the device. Then the program waits for at most *1* second to read from the device, which is stored in the *raw_data_in*.

After having closed the device “*dsqc328_1:*”, the read data is unpacked as a string of characters and stored in *answer*.

Arguments

ReadRawBytes IODevice RawData [\Time]

IODevice Data type: *iodev*

IODevice is the identifier of the device from which data shall be read.

RawData Data type: *rawbytes*

RawData is the data container where to store data read from *IODevice*, starting at index 1.

[\Time] Data type: *num*

The max. time for the reading operation (timeout) in seconds (resolution 0,001s). If this argument is not specified, the max. time is set to 60 seconds.

If this time runs out before the reading operation is finished, the error handler will be called with the error code ERR_DEV_MAXTIME. If there is no error handler, the execution will be stopped.

The timeout function is in use also during program stop and will be noticed in the RAPID program at program start.

Program execution

During program execution data is readed from the device indicated by *IODevice*.

If using *WriteRawBytes* for field bus commands, such as DeviceNet, the field bus always sends an answer. The answer must be handle in RAPID with the *ReadRawBytes* instruction.

The current length of valid bytes in the *RawData* variable is set to the readed number of bytes. The data start at index 1 in *RawData*.

Error handling

If an error occurs during reading, the system variable ERRNO is set to ERR_FILEACC.

If time out before the read operation is finished, nothing in the variable *RawData* is affected and the system variable ERRNO is set to ERR_DEV_MAXTIME.

These errors can then be dealt with by the error handler.

Syntax

ReadRawBytes
[IODevice ':='] < variable (**VAR**) of *iodev*> ','
[RawData ':='] < variable (**VAR**) of *rawbytes*> ','
['\' Time ':=' < expression (**IN**) of *num*>] ';'

Related information

	Described in:
rawbytes data	Data Types - *rawbytes*
Get the length of *rawbytes* data	Functions - *RawBytesLen*
Clear the contents of *rawbytes* data	Instructions - *ClearRawBytes*
Copy the contents of *rawbytes* data	Instructions - *CopyRawBytes*
Pack DeviceNet header into *rawbytes* data	Instructions - *PackDNHeader*
Pack data into *rawbytes* data	Instructions - *PackRawBytes*
Write *rawbytes* data	Instructions - *WriteRawBytes*
Unpack data from *rawbytes* data	Instructions - *UnpackRawBytes*

RemoveDir - Delete a directory

RemoveDir is used to remove a directory.

The user must have write and execute permission for the directory and the directory must be empty.

Examples

RemoveDir “HOME:/mydir”;

In this example, the *mydir* directory under *HOME: is deleted.*

Arguments

RemoveDir **Path**

Path Data type: *string*

The name of the directory to be removed, specified with full or relative path.

Error handling

If the directory does not exist, or the directory is not empty, or the user has not write and execute permission to the library, the system variable ERRNO is set to ERR_FILEACC. This error can then be handled in the error handler.

Syntax

RemoveDir
[Path’:=’] < expression (**IN**) of *string*>’;’

Related information

	Described in:
Directory	dir
Make a directory	MakeDir
Open a directory	OpenDir
Read a directory	ReadDir
Close a directory	CloseDir

RemoveFile - Delete a file

RemoveFile is used to remove a file. The user must have write and execute permission for the directory where the file resides and write permission for the file itself.

Examples

RemoveFile “HOME:/mydir/myfile.log”;

In this example, the file *myfile.log* in directory *mydir* on disk *HOME:* is deleted.

Arguments

RemoveFile **Path**

Path Data type: *string*

The name of the file to be deleted, specified with full or relative path.

Error handling

If the file does not exist, the system variable ERRNO is set to ERR_FILEACC. This error can then be handled in the error handler.

Syntax

RemoveFile
[Path’:=’] < expression (**IN**) of *string*>’;’ Related information

Related information

	Described in:
Make a directory	MakeDir
Remove a directory	RemoveDir

RenameFile - Rename a file

RenameFile is used to give a new name to an existing file. It can also be used to move a file from one place to another in the directory structure.

Examples

RenameFile “HOME:/myfile”, “HOME:/yourfile;

The file *myfile* is given the name *yourfile*.

RenameFile “HOME:/myfile”, “HOME:/mydir/yourfile”;

The file *myfile* is given the name *yourfile* and is moved to the directory *mydir.*

Arguments

RenameFile OldPath NewPath

OldPath Data type: *string*

The complete path of the file to be renamed.

NewPath Data type: *string*

The complete path of the renamed file.

Program execution

The file specified in *OldPath* will be given the name specified in *NewPath*. If the path in *NewPath* is different from the path in *OldPath*, the file will also be moved to the new location.

Error Handling

If the file specified in *NewPath* already exists, the system variable ERRNO is set to ERR_FILEEXIST. This error can then be handled in the error handler.

Syntax

RenameFile
[OldPath ’:=’] < expression (**IN**) of *string* > ’,’
[NewPath ’:=’] < expression (**IN**) of *string* >’;’

Related information

	Described in:
Opening (etc.) of files	RAPID Summary - Communication

Reset - Resets a digital output signal

Reset is used to reset the value of a digital output signal to zero.

Examples

Reset do15;

The signal *do15* is set to 0.

Reset weld;

The signal *weld* is set to 0.

Arguments

Reset Signal

Signal Data type: *signaldo*

The name of the signal to be reset to zero.

Program execution

The true value depends on the configuration of the signal. If the signal is inverted in the system parameters, this instruction causes the physical channel to be set to 1.

Error handling

Following recoverable error can be generated. The error can be handled in an error handler. The system variable ERRNO will be set to:

ERR_NORUNUNIT if there is no contact with the unit

Syntax

Reset
[Signal ':='] < variable (**VAR**) of *signaldo* > ';'

Related information

	Described in:
Setting a digital output signal	Instructions - Set
Input/Output instructions	RAPID Summary - Input and Output Signals
Input/Output functionality in general	Motion and I/O Principles -I/O Principles
Configuration of I/O	System Parameters

RestoPath - Restores the path after an interrupt

RestoPath is used to restore a path that was stored at a previous stage using the instruction *StorePath*.

This instruction can only be used in the *Main* task or, if in a MultiMove System, in Motion tasks.

Example

RestoPath;

Restores the path that was stored earlier using *StorePath*.

Program execution

The current movement path of the robot and the external axes is deleted and the path stored earlier using *StorePath* is restored. Nothing moves, however, until the instruction *StartMove* is executed or a return is made using *RETRY* from an error handler.

Example

```
ArcL p100, v100, seam1, weld5 \Weave:=weave1, z10, gun1;
...
ERROR
        IF ERRNO=AW_WELD_ERR THEN
            gun_cleaning;
            StartMoveRetry;
        ENDIF
...
PROC gun_cleaning()
        VAR robtarget p1;
        StorePath;
        p1 := CRobT();
        MoveL pclean, v100, fine, gun1;
        ...
        MoveL p1, v100, fine, gun1;
        RestoPath;
ENDPROC
```

In the event of a welding error, program execution continues in the error handler of the routine, which, in turn, calls *gun_cleaning*. The movement path being executed at the time is then stored and the robot moves to the position *pclean* where the error is rectified. When this has been done, the robot returns to the position where the error occurred, *p1*, and stores the original movement once again. The weld then automatically restarts, meaning that the robot is first reversed along the path before welding starts and ordinary program execution can continue.

Limitations

Only the movement path data is stored with the instruction *StorePath*.
If the user wants to order movements on the new path level, the actual stop position must be stored directly after *StorePath* and before *RestoPath* make a movement to the stored stop position on the path.

Syntax

RestoPath';'

Related information

	Described in:
Storing paths	Instructions - StorePath

RETURN - Finishes execution of a routine

RETURN is used to finish the execution of a routine. If the routine is a function, the function value is also returned.

Examples

```
errormessage;
Set do1;
   .

PROC errormessage()
   TPWrite "ERROR";
   RETURN;
ENDPROC
```

The *errormessage* procedure is called. When the procedure arrives at the RETURN instruction, program execution returns to the instruction following the procedure call, *Set do1*.

```
FUNC num abs_value(num value)
   IF value<0 THEN
      RETURN -value;
   ELSE
      RETURN value;
   ENDIF
ENDFUNC
```

The function returns the absolute value of a number.

Arguments

RETURN [Return value]

Return value Data type: According to the function declaration

The return value of a function.

The return value must be specified in a RETURN instruction present in a function.

If the instruction is present in a procedure or trap routine, a return value may not be specified.

Program execution

The result of the *RETURN* instruction may vary, depending on the type of routine it is used in:

- Main routine: If a program stop has been ordered at the end of the cycle, the program stops. Otherwise, program execution continues with the first instruction of the main routine.
- Procedure:Program execution continues with the instruction following the procedure call.
- Function:Returns the value of the function.
- Trap routine:Program execution continues from where the interrupt occurred.
- Error handler:In a procedure:
  Program execution continues with the routine that called the routine with the error handler (with the instruction following the procedure call).

In a function:
The function value is returned.

Syntax

(EBNF)
RETURN [<expression>]';'

Related information

	Described in:
Functions and Procedures	Basic Characteristics - Routines
Trap routines	Basic Characteristics - Interrupts
Error handlers	Basic Characteristics - Error Recovery

Rewind - Rewind file position

Rewind sets the file position to the beginning of the file.

Example

Rewind iodev1;

The file referred to by *iodev1* will have the file position set to the beginning of the file.

Arguments

Rewind IODevice

IODevice Data type: *iodev*

Name (reference) of the file to be rewound.

Program execution

The specified file is rewound to the beginning.

Example

```
! IO device and numeric variable for use together with a binary file
VAR iodev dev;
VAR num bindata;

! Open the binary file with \Write switch to erase old contents
Open "HOME:"\File := "bin_file",dev \Write;
Close dev;

! Open the binary file with \Bin switch for binary read and write access
Open "HOME:"\File := "bin_file",dev \Bin;
WriteStrBin dev,"Hello world";

! Rewind the file pointer to the beginning of the binary file
! Read contents of the file and write the binary result on TP
! (gives 72 101 108 108 111 32 119 111 114 108 100 )
Rewind dev;
bindata := ReadBin(dev);
WHILE bindata <> EOF_BIN DO
                        TPWrite " " \Num:=bindata;
```

```
                    bindata := ReadBin(dev);
ENDWHILE

! Close the binary file
Close dev;
```

The instruction *Rewind* is used to rewind a binary file to the beginning so that the contents of the file can be read back with *ReadBin*.

Error handling

If an error occurs during the rewind, the system variable ERRNO is set to ERR_FILEACC. This error can then be handled in the error handler.

Syntax

Rewind
[IODevice ':='] <variable (**VAR**) of *iodev*>';'

Related information

	Described in:
Opening (etc.) of files	RAPID Summary - Communication

RETRY - Resume execution after an error

The *RETRY* instruction is used to resume program execution after an error, starting with (re-executing) the instruction that caused the error.

Example

```
reg2 := reg3/reg4;
   .
ERROR
   IF ERRNO = ERR_DIVZERO THEN
      reg4 := 1;
      RETRY;
   ENDIF
```

An attempt is made to divide *reg3* by *reg4*. If reg4 is equal to 0 (division by zero), a jump is made to the error handler, which initialises reg4. The *RETRY* instruction is then used to jump from the error handler and another attempt is made to complete the division.

Program execution

Program execution continues with (re-executes) the instruction that caused the error.

Error handling

If the maximum number of retries (4 retries) is exceeded, the program execution stops with an error message. The maximum number of retries can be configured in *System Parameters (System miscellaneous)*.

Limitations

The instruction can only exist in a routine's error handler. If the error was created using a *RAISE* instruction, program execution cannot be restarted with a *RETRY* instruction, then the instruction *TRYNEXT* should be used.

Syntax

RETRY ';'

Related information

	Described in:
Error handlers	Basic Characteristics-Error Recovery
Configure maximum number of retries	System Parameters - System miscellaneous
Continue with the next instruction	Instructions - TRYNEXT

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WriteStrBin 375

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